PROCEEDINGS OF THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

1942

IMPERIAL MYCOLOGICAL INSTITUTE
13 JUN 1945

THIRTY-FOURTH ANNUAL MEETING
LEXINGTON, KENTUCKY
JULY 28-31, 1942

PROCEEDINGS OF THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

1942

THIRTY-FOURTH ANNUAL MEETING
LEXINGTON, KENTUCKY
JULY 28-31, 1942

Published by the Association
Publications Committee

Edited by M. T. Munn
Geneva, N. Y.
Feb. 1943

Printed in U.S.A.
EDWARDS BROTHERS, INC.
LITHOPRINTERS
ANN ARBOR, MICHIGAN
1943

THIRTY-FOURTH ANNUAL MEETING

OFFICERS AND COMMITTEES

1941-1942

OFFICERS

F. A. McLaughlin, Amherst, Mass. . . . . President
Charles A. Stahl, Lansing, Mich. . . . . Vice-President
Elva L. Norris, Manhattan, Kansas. . . . Secretary-Treasurer

STANDING COMMITTEES

EDITORIAL

M. T. Munn, Chairman
Edith Higgins, Historian
C. N. McIntyre, News Letter
W. H. Wright, Handbook

LEGISLATIVE

R. C. Kinch, Chairman
W. F. Cameron
Henry Lunz
Marvin H. Snyder

MEMBERSHIP

Joseph E. Barnes, Chairman
Leroy Everson
A. Hope
Letha B. Howard
Henry Lunz
Regina B. Schulte
J. W. Woodside

PUBLIC SERVICE

John E. Casey, Chairman
A. S. Carter
Leroy Everson
E. L. Erickson
E. R. Jackman
O. L. Justice
Bessie G. Sanborn
C. F. Simmons
Frank H. Spanier

RESEARCH

G. P. Steinbauer, Chairman
N. G. Lewis, Region 1
A. C. Heise, " 2
G. P. Steinbauer, " 3
P. A. Lehenbauer, " 4
C. M. Bass, " 5

RULES AND REGULATIONS

W. C. Pfaender, Chairman
George A. Elliott
G. T. French
Letha B. Howard
Elva L. Norris

SPECIAL COMMITTEES

PROGRAM

C. N. McIntyre, Chairman
Edith Higgins
F. A. McLaughlin
W. A. Price
C. A. Stahl
G. P. Steinbauer

STANDARDIZED TESTS

R. H. Porter, Chairman
W. C. Pfaender
G. P. Steinbauer
W. H. Wright

SUB-COMMITTEES

PROJECT	CHAIRMAN
Hard Seeds	W. O. Whitcome
Methods Analysis Small Seeds	Louisa A. Kanipe
Phytopathological Studies	W. D. Hay
Range Grass Seed Studies	Elva Norris, Anna Decker
Sand Tests	C. W. Leggatt
Viability Injured Weed Seeds	Dorcas Hooker

THE BUSINESS OF THE ASSOCIATION

REPORT OF THE EXECUTIVE BOARD

The meeting of the executive board was held at Lexington, Kentucky, July 27, 1942. Members present were Messrs. Munn, Stahl, Steinbauer, Woodside, Acting Chairman Snyder, Acting Chairman Justice, McIntyre, McLaughlin, and Miss Norris.

The following reports were presented, discussed and approved: News Letter Editor, Handbook Editor, Editorial Committee, Membership Committee, Rules Committee, Public Relations Committee, Handbook Committee, Program Committee, Research Committee, and Legislative Committee.

Action was taken on the following recommendations:

I. It was moved and carried that the results of the referee analyses and tests as such be not published in the Proceedings or regular publications of the Association.

II. It was moved and carried that the Association empower the executive committee to carry forward the full activities of the Association for the duration in the event that it is deemed inadvisable to hold annual meetings. - F. A. McLaughlin

MINUTES

The thirty-fourth annual meeting of the Association of Official Seed Analysts was held at the University of Kentucky, Lexington, Kentucky, on July 28-30, 1942. The following actions were taken at the meeting:

I. The report of the executive board was read and the recommendations were accepted with the following amendments to Recommendation I:

> "A referee test is a test carried out to check the uniformity of the work of laboratories when using the official method."
>
> "The decision as to what constitutes a referee test or other type of research data be left to the judgment of the Research Committee."

II. It was voted that reports and papers of the Association be published and the chairman of the Editorial Committee submit bids for printing and planographing and at the same time consider ways and means of reducing the size where feasible.

III. The Report of the Public Service Committee which was based upon information received from forty-two states was approved and accepted.

IV. The Report of the Legislative Committee which dealt with the extent to which state laboratories are following or are in favor of a uniform seed bill was approved and accepted.

V. The Association voted to accept the following report of the Rules and Regulations Committee:

At the last annual meeting the Association passed a resolution instructing the incoming committee to revise the Association's rules so that they would fit in as closely as feasible with the Federal Seed Act rules and regulations. The Committee makes these recommendations.

> 1. That the proposed rules be given the first approval by the Association at this meeting with the stipulation that mimeographed copies be prepared and distributed to all members of the Association by the incoming committee on rules and regulations with the view that everyone may study the proposed rules carefully and make proposals for additions or changes.
>
> 2. That the incoming committee, after having given due consideration to all proposals and recommendations, prepare a final draft of the proposed rules to be presented at the meeting a year hence for final adoption or rejection.

VI. The following report of the Membership Committee was approved:

"Your Membership Committee presents for consideration the Georgia Laboratory as a member laboratory. The following names are submitted for honorary membership:

Miss Jessie C. Ayres
Miss Anna M. Lute
Mr. Edgar Brown
Mr. W. J. Lackey

"We also recommend that Miss Albina Musil, Mrs. Vivian K. Toole and Dr. E. H. Toole of the United States Department of Agriculture and Dr. C. W. Leggatt of the Seed Research Laboratory at Ottawa, Canada, be elected associate members. These persons are engaged in seed research work but are not affiliated with a member laboratory."

VII. The following requests made by the Commercial Seed Analysts Association were accepted and referred to the proper committees:

I. 1. We request that the Rules and Regulations Committee of the Committee of the Official Seed Analysts keep in the new rules and regulations for testing seed, the sentence in Section 4, LABORATORY GERMINATION, (d) Duration of Test - "If however, germination does not seem to be completed in this time, additional time should be given."

2. We request the Rules and Regulations Committee of the Official Analysts Association that they investigate alternate germination methods for the testing of the various seeds and give such methods in the Rules for Seed Testing to be used as a guide in retesting lots that do not respond to the prescribed methods.

3. We request that the Association of Official Seed Analysts undertake to standardize the quality and intensity of light in relation to "daylight" in germination of seeds.

4. We request the Association of Official Seed Analysts investigate the viability of Wild Onion bulblets as a means to their classification as a weed seed or inert matter.

II. Due to the increased emphasis on the classification of "baldheads" in germination of beans, we recommend to the Association of Official Seed Analysts that they suggest that their member states consider reducing the germination standard of beans to recompense for the lower germination caused by this classification.

VIII. The Association adopted the following recommendations from the Committee on Standardized Tests:

(1) That its efforts to promote standardization and uniformity of methods for seed testing in seed laboratories be continued.

(2) That the membership of the committee be officially recognized as including at least one representative each from the Canadian and United States Departments of Agriculture, the chairmen of the Research and Rules Committees of the Association and one additional member from the Association at large to be appointed by the President. The chairman of the committee shall be appointed by the President to serve for a period of three years.

(3) That projects be those which have been carried to a reasonably satisfactory conclusion insofar as research is concerned and which offer promise of establishing uniform procedures in all laboratories.

(4) That from time to time the committee publish the results of its findings and present recommendations to the Association for the adoption of such procedures as it is believed are necessary to uniformity in seed testing.

IX. It was moved and carried that the Secretary have a reprint made of the article, "Qualifications of Seed Analysts," and send copies to directors of all seed laboratories.

X. The Association voted that the Executive Committee should investigate the advisability of increasing dues by sending letters of inquiry to the various laboratories and thus obtain their expression on the matter.

XI. The following report of the Resolutions Committee was accepted:

The Committee recommends that the Association express a vote of thanks and appreciation to the persons hereinafter mentioned, and that the Secretary be requested to forward an appropriate letter in the near future:

Thos. P. Cooper, Dean of the Kentucky School of Agriculture and Director of the Experiment Station

W. A. Price, Director of Kentucky State Seed Laboratory, and Mrs. Price

Miss A. Lemback, who was in charge of Patterson Hall

Members of the Kentucky Seed Laboratory staff

O. M. Farrington, who supplied the gladioli

John Jacob Niles, composer and folksong authority, who so pleasantly entertained us with "Ballads of the South Land"

XII. The Association took action to allow the Secretary to make special prices on old copies of the Proceedings.

XIII. C. A. Stahl automatically succeeded F. A. McLaughlin as president of the Association and was duly inducted into that office. The Association elected N. G. Lewis, Calgary, Canada, to be vice-president and Elva L. Norris was re-elected secretary-treasurer.

XIV. The chairmen of the standing and special committees were appointed by President Stahl as follows:

Editorial - M. T. Munn, Experiment Station, Geneva, New York

Legislative - R. C. Kinch, State Seed Laboratory, Lincoln, Nebraska

Membership - J. W. Woodside, State Department of Agriculture, Raleigh, North Carolina

Public Service - John E. Casey, College of Agriculture, Fayetteville, Arkansas

Research - George P. Steinbauer, Experiment Station, Orono, Maine

Rules and Regulations - W. C. Pfaender, Agricultural Marketing Service, Beltsville, Maryland

Standardized Tests - R. H. Porter, Iowa State College, Ames, Iowa

TREASURER'S REPORT

Oct. 10, 1941, to July 31, 1942

Balance as of October 10, 1941		$999.36	
Receipts:			
Laboratory dues	$540.00		
Proceedings	85.00		
News Letter	38.75		
Index for News Letter	19.80		
Miscellaneous	8.91	692.46	
			$1,691.82
Disbursements:			
Proceedings	$305.50		
News Letter	93.79		
Postage, stationery,	45.52		
History	120.00		
Index for News Letter	75.00		
Miscellaneous	82.48	722.29	
Balance as of July 31, 1942		969.53	
			$1,691.82

As of July 31, 1942:

Checking account	462.87
Union National Bank	506.66
	$969.53

(Signed) Elva L. Norris
Secretary-Treasurer

Approved by Auditing Committee:
Chas. A. Stahl
Edith C. Higgins

REPORT OF THE AUDITING COMMITTEE ON JULY 28, 1942

The Auditing Committee has examined the books and records of the treasurer of the Association of Official Seed Analysts and finds them to be correct and accurate in every detail.

Respectfully submitted,

(Signed) Chas. A. Stahl

Edith C. Higgins

REPORT OF THE EDITORIAL COMMITTEE

The work of this committee,as outlined in the constitution, is divided into five parts each with a separate sphere yet all closely related. Each editor has worked largely independently yet conferences and correspondence have served as far as practical to guide the official publications of the Association. Each editor has submitted an independent report which follows:

The Proceedings of the Association have been carefully edited to maintain high standards and along the lines previously laid down by the Association and in keeping with the stated policy of accepting much "briefer committee reports containing only material of permanent value." It is provided that the Annual Proceedings shall embrace reports, papers and the minutes of the annual meeting and shall be edited by the editorial committee. There is ample provision made for the editing, publication and distribution of all types of publishable material each in its particular sphere and usefulness.

There has been some delay in the appearance of the Proceedings. We might blame it on the war which does bring situations wholly beyond our control and does impose extra duties upon many so that they are not so free to undertake these real extra activities. Our meeting was held in August of 1942 and despite the fact that it was suggested that all manuscripts were to be at hand at the close of the meeting some did not arrive in completed form until late in 1943. The Proceedings can move only as fast as the slowest paper or report after which may come delays in getting bids, estimates and printers' delays. To be adamant and accept nothing after a specified date may be an ideal approach to the problem but taking a long view of the situation this past year some exclent reports and papers would have been excluded since there was delay in getting their release. There is a definite expressed feeling among our membership that we should not sacrifice quality for speed. That authors should present considered, accurate and intelligible papers and reports, not haphazard or offhand writing since the Proceedings once off the press are a permanent record of which the Association should be proud.

The work of a bibliographer has been somewhat limited with the almost complete cessation of foreign publications. An interesting study has been made of the formal reports which come from the various member laboratories. New ideas and attempts in the form of illustrative material have appeared in an effort to more effectively serve the public and at the same time present the work of the seed laboratory. Based upon the number received it would appear that the once accepted, long and often delayed, detailed tabular form of bulletin with pages of double figures is giving way to a more concise, illustrated, seasonable seed report showing to the inquiring buyer who is selling what and how and where. In the field of seed research some notable contributions have appeared during the year. When the stress of the present days is past it would be worthwhile to recount the progress in seed research. - M. T. Munn, Chairman.

REPORT OF THE EDITOR OF THE NEWS LETTER

During the past year the editor has been confronted with a number of problems which he believes are of sufficient importance to cause them to be presented to the association. It would seem that if the News Letter is to go into the 16th year of publication some special attention is in order to better determine its place as a publication of the association.

Perhaps you are well aware that the editors of the NewsLetter in the past, as well as the present one, have never received very definite instructions concerning the type of publication desired. Therefore, I am propounding a number of questions for consideration. Should the publication be considered as only a house organ? How should we consider the material that is submitted for publication? By that I mean should the material be submitted to the editorial committee as a whole? Should the News Letter be used as a means of disseminating cuts or photographs of general interest to seed analysts? Should the publication contain material from non-members? Should the publication have definite dates? Is it desired that the publication have covers of similar quality to the index or proceeding, using in general the standard type of printing familiar to all? Should the publication be distributed to libraries? What about the rule concerning mailing of extra copies to member laboratories?

It has been suggested that sub-departments be created, perhaps one dealing with personnel, another research, review of publication, etc. These departments being responsible to the editor for the obtaining of information. It is possible that these members would not necessarily constitute membership in the editorial committee.

Personally, I feel sure that any editor in the past would have appreciated knowing just what the association wanted or expected and that editors in the future would likewise desire to know the limitations of their responsibilities. In the absence of definite instructions, I have considered the News Editor as the co-ordinator of the efforts of the members of the association to reveal to others, things of interest--personal items, investigational work, or articles for the promotion of discussion which might end in the improvement of the work of the association or the function of any committee, and certainly an organ designed to promote goodwill among the members.

I feel sure that the members do not recognize the responsibility which is placed on the editorial committee of which the News Letter Editor is only one member. In the absence of any definite instructions it may be that the News Letter Editor should have worked more fully with other members of this committee, but experience seems to indicate that one of the best ways to get something done is merely to take matters into ones own hands and do the best one can. This may not be the proper attitude. It seems to have been the only method which worked.

Statistically, the News Letter this year consisted of six editions appearing in August, October, December, February, May and July respectively. Distribution was made to 64 official laboratories, 9 honorary members, 45 commercial laboratories paying subscriptions and 4 complimentary, or a total of 747 copies.

I am hopeful that the members will fully discuss these problems at this meeting, especially so in the face of complications that may prevent our meeting in the future, at least for the duration of the war. The editor is entitled to your opinion so that he may be guided in the handling of this publication. - C. N. McIntyre, Editor

REPORT OF THE HANDBOOK

The Handbook is apparently quite popular, judging by the number of requests for copies. These are being distributed to seed analysts both official and commercial on request. A few have been sent to colleges of agriculture, and to libraries.

Apparently there is a real need for sections dealing with identification of seeds, as there is more demand for these than the sections dealing with other topics. The section on Lychnis and Silene has become exhausted so that more copies should be prepared.

This year the following contributions were prepared:

(1) The Identification of Seeds, Generic, Specific and Varietal, by Albina F. Musil.
(2) The Importance of Weed Seed Identification, by Albina F. Musil.
(3) Wild Oats, False Wild Oats and Heterozygous False Wild Oats, by W. H. Wright.
(4) Seed Longevity and Seed Storage, by E. H. Toole. This is a revision of the contribution of 1941.
(5) Purity Analysis, Size of Sample, by C. W. Leggatt.
(6) Accuracy of Tests and Tolerances, by C. W. Leggatt.
(7) Sources of Variation in Purity Analysis, by C. W. Leggatt.

The Editor finds it very difficult to get members of the Association to prepare contributions. Few people have time to prepare papers, especially on the identification of seeds. The editor is most anxious to receive suggestions regarding the type of article which should be included in the handbook.

Copies of the 1942 Contributions have been sent to all analysts both official and commercial on the editor's mailing-list. - W. H. Wright.

REPORT OF LEGISLATIVE COMMITTEE

The work of the legislative committee got under way with a rather late start. The report of the committee for last year was ably prepared by W. F. Cameron of Illinois and presented in the February 1942 issue of the News Letter.

The work of the committee for this year began where the previously referred to report left off, and was carried out along the same line of procedure. Information and data were gathered from the various states on the reaction of the states (particularly state legislatures) to the proposed uniform state seed law.

The year of 1941 should be a memorial year in the history of seed testing work in the United States. It was in July of 1941 when the seed law of the state of Georgia, closely modeled after the proposed uniform state seed law, went into effect. Now every state in the United States has a seed law on its statute books. It is unfortunate that a number of states do not have up-to-date seed laws which provide adequate funds and efficient administrative machinery, but it can now be said that every state has a seed law.

No draft of a law can be expected to satisfy every interested individual or group. Although the proposed Uniform State Seed Law was drafted and redrafted several times before presented to the Association in 1940, there were a number of points on which opinion was not unanimous at the time of its adoption by the Association.

After the Association had adopted a draft of the Uniform State Seed

law, the law was mimeographed and sent to the several states with the recommendation that the states enact a new law or amend their present one so as to conform as closely as possible with the recommended law.

There is no need to enumerate here the reasons why states should have uniform seed laws, but one can readily visualize how much simpler the task of the Agricultural Marketing Administration would be if state laws were uniform throughout the country. The problems of administration and enforcement could be much more thoroughly discussed at the annual meetings of the Association and a great deal more information exchanged if this were the case.

A state seed law must necessarily meet the needs of the state. There is very little, if anything, in the proposed Uniform State Seed Law, outside of statutory limitations on the promulgation of regulations, that needs changing from state to state. Noxious weed regulations, of course, must be developed according to regions but the Agricultural Marketing Administration and the State Agricultural Experiment Stations have up-to-date information on the extent of infestation and seriousness of noxious weeds.

REACTION OF STATES TO PROPOSED UNIFORM STATE SEED LAW

A questionnaire was sent to each state in an effort to obtain information on the reception of the proposed Uniform State Seed Law by the state legislatures and interested organizations in each state.

No reply was received from four states but by correspondence with others and checking publications, an estimation of activity of the states not reporting was obtained.

Seventeen states were found to have enacted new laws or changed their existing laws since the proposed Uniform State Seed Law was adopted by this association in 1940. One state enacted a law which did not appear to conform to the present proposed Uniform Law while the other sixteen more or less conformed to the proposed law. Of the thirty-one states which did not change their laws, eleven indicated that there had been activity or a definite movement to have the law changed. One very interesting and encouraging thing brought out by the questionnaire was that out of the twenty-eight reported changes or attempts to change the law, twenty-one were complete seed laws and only seven were amendments to the existing law.

From the results and experiences of these states it would seem that the more desirable way to change a seed law is to replace it with a complete law. Only one state reported unfavorable reaction to the length of their proposed seed law.

The farmer exemption clause, as usual, proved to be the hottest point of contention in state legislatures. Four of the eleven states which reported failure in their efforts to change the law cited the farmer exemption clause as one of the chief obstacles. In Nebraska elimination of a farmer exemption clause was cited as the sole reason the bill failed to receive favorable action.

Of the sixteen states that had copies of their new seed laws available, seven did not contain a farmer exemption clause while seven had a farmer exemption clause and two states had limited farmer exemption provisions.

Lack of active interest on the part of some legislatures was listed as a reason why passage failed in some cases. Active opposition on the part of some state legislators or by the seed trade were also listed as reasons why efforts failed.

It was indicated that wherever efforts to change the existing seed law had failed, another attempt would be made in the near future. Five states where no action had been taken as yet indicated that some action would be taken at the next session of their legislature.

In summing up the reaction of the states to the Proposed Uniform State Seed Law, there are sixteen states that have changed their existing laws to conform with the proposed law, eleven states that attempted and will try again and five that expect to take some action, making a total of thirty-two states where some action has been or will shortly be taken. Undoubtedly other states may take some action by the time state legislatures meet again next year.

It should not be construed that states which have not taken any action in adopting the proposed Uniform State Seed Law are not effectively enforcing a seed law. Several states have good seed laws and are enforcing them well. These states would rather continue with their present effective program rather than take a chance with their state legislatures in possibly getting a less satisfactory one.

ORGANIZATION FOR AN EFFECTIVE SEED LEGISLATION PROGRAM

A state seed council was regarded as the most effective organization in bringing together interested groups and organizations which would push a seed legislation program. A good council would bring together experiment station, extension and state department officials, farmer organizations and commercial interests. Occasionally, in using the words of L. A. Moore, well-known former director of the Illinois Seed Laboratory, "Self appointed guardians of Agriculture" are found in legislatures who block or delay a well-built program of legislation. Situations of this kind are unfortunate and can only be met with time and patience in their own particular way.

In developing an effective seed council, generally the president or chairman and secretary of the organizations represented, if interested in the program, would lend sufficient weight to influence entire organizations. In taking the experience of states where a seed control program has been successful, it was found that the more the organizations and representatives of the organizations were in agreement before the bill was presented to the legislature, the easier it was to send the bill unchanged through the legislature.

The committee wishes to express its appreciation to those who have given their valuable experience and opinions to make this survey possible.--R. C. Kinch, chairman

REPORT OF THE PUBLIC SERVICE COMMITTEE

The report of your public service committee this year seeks to serve as a clearing house for activities and ideas for activities in which seed laboratories are or might well be participating in the interest of better seed for the public. In collecting the data, emphasis was placed on cooperation with the various agencies within the state, particularly the agricultural extension service, and questionnaires in many instances were answered by both seed analyst and representative of extension work.

Through the efficient work of the members of the committee, the chairman received reports from forty-two states; it is possible that the other six states failed to respond because of oversight on the part of the committee or the analyst concerned rather than because of unwillingness

to enter into the symposium. There was a degree of variation in the questions sent to various groups of states, and, as already mentioned, representatives of several agencies made answer; the results therefore cannot be strictly tabulated, but we wish here to give a summary of our findings and shall be glad to furnish such limited statistical data as have been obtained to any one desiring the information, or from our files to aid in making contacts between those states which have experience in certain programs and other states interested in hearing more about them.

With modifications, responses were requested on four general topics: first, things being done in each state to make the farmer more seed-conscious; second, the means considered best for accomplishing this public service; third, the cooperation existing between seed laboratories and the agricultural extension service; and fourth, suggestions for improving this cooperation which seems so vital to most seed workers.

A seed laboratory's first contribution to public welfare is, of course, seed testing; in the list of activities to aid the farmer, several states thought that testing of farmers' samples might be given special mention. One state also reported as beneficial an effort to test mail order seed sent direct to the farmer. Among other activities in which seed laboratories participated in greater or less degree, seed exhibits were most frequently found, then such time-proved methods of publicity as news releases and radio programs, and, third in popularity, meetings at which seed and weed problems are discussed. Seed schools were reported by eight states, and two reported seed clinics to which the farmer can bring his seed for diagnosis. Seed laboratories assist in educational work by supplying in many instances instructional or demonstration material for college courses, especially those in weeds and seeds. Several states have well-organized weed control programs in which all agencies interested in better seed are concerned; fewer have seed-cleaning centers. Other items listed were special bulletins, contests, published reports, field days, visits of special groups to the laboratory, and farm-to-farm survey of clover seed production. In states where there is a crop improvement program through a Crop Improvement Association, Seed Growers' League, or similar organization or through the certification of seed, the seed laboratories assist materially by testing the approved seed, and certain states consider that such a program does more than anything else to make the farmer good-seed-conscious.

Only one respondent suggested that the farmer should be educated to good seed "the hard way," that is by planting bad seed, though several inclined to the attitude that experience is the best teacher, particularly when experience speaks in terms of cash. Twelve states emphasized education and "perpetual publicity;" on the other hand, while six states felt that they should list a seed law, well enforced, as the basis of good-seed work and doubtles many more, while not making definite statement, would agree, only one, and that not a seed-producing state, listed it as sufficient in itself. Other suggestions were: seed-cleaning facilities; exhibits, slides and movies; seed laboratory reports and publishing of violations; field demonstrations (these were in high favor); expanded program of testing farmers' seed (though one analyst admitted that he had not found the secret of getting samples in early or getting five-thousand samples tested the second week of February); contact with farmers through inspectors, who should be well-qualified and plentiful enough to do the work, and through county agents and farm organizations; seed certification; a crop improvement association; and enlisting the interest of dealers.

The extent of cooperation with the agricultural extension service

ranges from that in one state where county agents are known to the laboratory chiefly as distributors of poor seed to that in the state where the seed laboratory is under the direction of the extension service. Of thirty states making statement on this subject, two reported no cooperation between the laboratory and the extension service; four classified themselves as having very little cooperation; seven in which there is some definite cooperation, as assistance given by county agents in taking samples and reporting violations or cooperation in field tests, but not so much as the laboratories desire, can best be ranked as fair; two find their cooperation much improved (one, in part, because of cooperative seed schools); and fourteen considered that the cooperation is good, because of organized programs or personal helpfulness. The Idaho laboratory, a part of the extension service, reported that the cooperation is perfect. In this connection, cooperation between Crop Improvement Associations and certification agencies should be recalled.

Very evidently the first prerequisite to betterment of cooperation is felt by most people to be a working agreement between the two agencies and reciprocal knowledge of their work. Meetings for representatives of the two groups were suggested as the best means to attain this end by three states, one of which had tried it with good results. Others suggested coordination under a full-time worker or under a state seed council, which has been tried successfully in at least one state. Others rather threw the flame on the extension service in suggesting that extension workers should show more interest in seeds, but one state suggested as an opening wedge that the laboratory should supply information to extension and another suggested cooperative exhibits.

Of considerable interest are the questions which are brought up on which various analysts would like more information. Some of these topics may suggest work for a future public service committee. These briefly stated are; percentage of laboratory time that should be given to farmers' samples; attitude toward encouraging farmers to test seed at home; how to encourage the farmer to have his seed recleaned; the value of published reports of various types; and the regulation of the sale of vegetable seed. On this last item we quote one analyst: "A request I would like to place before your committee is a matter of enforcing purity regulations of vegetable seeds. We have encountered two small lots of vegetable seeds containing Field Bindweed shipped into the State by out-of-state seed companies... The Federal Seed Act [might] be amended to require purity analysis of vegetable seeds." The problem of cooperation between laboratory and seed enforcement officials is still a burning one in some states, as is that of obtaining efficient inspectors. Seed law enforcement officials are often too political-minded for best cooperative efforts to carry out the intents and purposes of seed laws.

It has been suggested that the public service committee might act as a clearing house for placement of seed technicians as well as for the dissemination of information to the various laboratories, as a part of its duties to study methods having to do with the use of better seed and the publicizing of the results. It has been questioned whether seed laboratories should be encouraged to enter into elaborate weed control programs or seed production programs in any way other than by supplying data or tests, but in this report we have dealt with what is being done for seed improvement rather than the exact extent to which seed laboratories should participate. More definite statements along this line might be helpful to the member laboratories which are striving as they are to render a public service, though each laboratory will always have its own peculiar problems.-
John E. Casey, Chairman

REPORT OF RESEARCH COMMITTEE

G. P. Steinbauer, Chairman

Agricultural Experiment Station

Orono, Maine

The activities of the research committee have been directed toward the objective of securing greater uniformity in tests through the referee type of test and also through studies of possible improvements of techniques. In view of the diversity of problems to be considered the work was again conducted in a regional basis. Special problems were studied by subcommittees. It was gratifying to find a large number of laboratories taking part in these activities even though depletion of staffs and other factors associated with the war effort have often made such participation difficult.

Since the laboratories that took part in the tests have already received detailed reports on them much of the tabular material has been omitted and only a summary of procedures and results given. In certain instances where definite causes for variation between results could be determined and in tests aimed at improvement in techniques more detailed information is included. The reports of the regional chairmen and the subcommittees follow:

Report for Region No. 1 - Northwest

by N. G. Lewis,

Calgary, Alberta

Ten laboratories took part in tests carried out in Region No. 1. Three samples were tested. One of these, Number 2, required repeated tests until June. Results for it will be held over until next year.

Results from the third sample were obtained from laboratories employing media in different ways and even different media. Presumably, each laboratory used its regular method of testing mustard seed. This difference in technique in each laboratory, a difference attributable to local conditions determined by the analysts themselves or to the particular type of equipment used, is hardly consistent with what we are calling research programs. The program we have followed in Region 1 can be considered as primarily a referee program, in the sense that we are comparing results obtained at each laboratory without reference necessarily to the cause of differences between laboratories.

Test No. 1. - Wheat Damaged by Say's Grain Bug

A sample badly damaged by Say's Grain Bug was cleaned with approximately 30% dockage. The cleaned seed was tested by the ten laboratories of Region 1 with the following results from tests made in quadruplicate at 18° to 20°C.

Table I. - Germination of Wheat Damaged by Say's Grain Bug

	Germination in percent					
	Blotters			Sand		
	Normal	Weak	Dead	Normal	Weak	Dead
Aver.	70.48	6.7	23.5	67.1	6.4	26.9
Range	62.75 to 79			62.50 to 75		

Results vary beyond the limits of a Chi-square test for homogeneity. Mould infestation and sampling error for insect damage were factors contributing to this. A slight reduction in emergence of seedlings from sand compared with blotters is shown. It is obvious that considerable damage from Say's Grain Bug remained even after cleaning and that such grain should be tested when used for seed since the damage cannot be estimated from the appearance of the seed.

Test No. 3. - Dormancy in Cultivated Mustard and the Use of Potassium Nitrate

Two samples of cultivated mustard, Florida Broadleaf and Southern Curled were supplied by Macy Spracher of Northrup-King Company who recommended testing these in quadruplicate, in water and in .2% potassium nitrate using blotters on top of extra folds of blotting paper in petri dishes at 20° to 30°C in daylight.

Table II. - Germination of Mustard Varieties

Kind	Florida Broadleaf		Southern Curled	
Lab. No.	Normal sprouts		Normal sprouts	
	Water	KNO_3	Water	KNO_3
	%	%	%	%
1	31.50	99.25	71.25	91.75
2	98.00	98.67	90.00	91.00
3	96.50	99.75	94.00	92.50
4	34.00	96.25	49.50	91.75
5	76.25	98.00	87.25	88.25
6	90.50	98.50	86.00	91.00
7	64.00	97.75	82.00	90.75
8	59.00	98.25	71.75	91.75
9	95.00	98.00	70.75	94.50
10	85.00	94.00	91.25	88.25
Aver.	72.98	97.84	79.38	91.15
Range	31.50 to 98.0	94.00 to 99.75	49.50 to 94.00	88.25 to 94.50

The average number of normal sprouts plus hard seeds, which may be taken as the number of viable seeds in each variety were:- Florida Broadleaf 99% and Southern Curled 94%.

Discussion and Conclusions:

Tests made in water, produced wide differences in comparative

tests between laboratories. These differences were attributable to failure of viable seeds to germinate at certain laboratories. The cause of the differences was largely rendered inoperative by the use of potassium nitrate.

The cause of poor results in water may be attributed to poor light conditions according to evidence supplied by several laboratories. All laboratories reporting poor light conditions reported poor results from the use of water. Laboratory No. 4 checked poor north window light against artificial Neon light and obtained much higher results with the latter. Laboratory No. 7 reported poor light conditions. Laboratory No. 8, however, obtained high results in sand in both light and darkness and low results in darkness between blotters and in petri dishes using Vitamin B_1 solution and also water in the latter method of testing.

Hardly any two laboratories employed identical media. Despite this the KNO_3 method produced uniform results between laboratories.

Report for Region No. 2 - North Central

by A. C. Heise, Winnipeg, Manitoba

Introduction

In the fall of 1941 a questionnaire was mailed to the official and commercial seed testing laboratories in Region No. 2 with the object of (a) becoming acquainted with the equipment used in the several laboratories and (b) ascertaining the type of project in which the several laboratories are interested. The answers to (b) revealed a wide range of interests and suggested several problems for attack.

It was decided to continue the comparative tests of the germination of sweet clover seed this season. In the Winnipeg Laboratory the results of tests on a large number of lots of seed were watched until four lots were found which possessed the desired characteristics. In the first place, four samples were required which had very few hard seeds and very few dead seeds because tests of actual germination were sought. Second, the four samples were required to show a sequence of normal seedlings varying from a high percentage to a much lower percentage, in order to ascertain whether environmental germination conditions cause greater variations in different types of samples. Third, the four samples were required to show a sequence of abnormal seedlings varying from a low percentage to a much higher percentage in order to demonstrate whether the several laboratories were able to distinguish the different types, and in order to ascertain whether certain environmental conditions produced an excess of abnormals.

These specific characteristics were selected because of the published results of many previous comparative tests. Conclusions drawn from these previous results were that (a) an unknown set of conditions in the test itself causes variations between the results in different laboratories; (b) different laboratories use widely different germination techniques even though they conform with the rules; (c) different laboratories evaluate seedlings differently.

Enlarging on these three conclusions:

(a) - It is known, for example, that when sweet clover seed is planted between blotters and the blotters kept so wet that free water surrounds the seeds, a large number of abnormal seedlings result. Or, when the blotters are very soft and so pressed down that the paper practically enfolds the seeds, a large number of abnormals result.

(b) -"18 - 20°B. B." may mean any one of the following, in any combination:
The temperature may be ordinary room temperature without control; or may be held at an approximate level of 19°C, possibly varying from 18-20°; or may be held at 18° from 5 p.m. to 9 a.m., and at 20° from 9 a.m. to 5 p.m. The temperature may be controlled by hand or by thermostat, that is, the control may be only approximate or may be positive The control may be by heating, by refrigeration, or both.

The moisture in the blotters may range from slightly damp to so wet that free water shows.

Moisture in the blotters may be held at a constant level automatically or the blotters may be alternately dry and wet as they are sprinkled by hand, or the moisture level may gradually reduce as the test is continued.

In some laboratories the blotters in which the seed is placed are laid on a layer of wet blotters; in others they are laid directly on the bottom of the tray.

Some laboratories pile blotters one above another; others overlap the blotters; still others do neither, so that there is never more than one layer of blotter over the seeds at any time.

The blotters themselves are of different specifications. Some appear satisfactory in every way. Some are soft and tend to enfold seeds too closely. Some are colored with soluble dye which may or may not affect the development of the seedlings.

The germinating chamber may have a relative humidity ranging from 35% to 95%, may be automatically humidified, or have no control at all.

The chamber may be ventilated, equipped with forced air circulation, or have no ventilation nor circulation of air.

Some of the trays used have solid bottoms, while others have perforated or mesh bottoms.

The chamber may be lighted by daylight varying in intensity from 20 foot candles to 500 foot candles, or by incandescent lamps or by fluorescent lamps, also of different intensities, or be unlighted except when the door is opened.

Because there are so many variations in the technique actually used when the instruction is simply "18-20°, B.B.", and the variations cover so wide a range, it becomes of some importance to discover which factors affect results favorably and which adversely.

(b) - Lack of agreement between tests "B. B." and tests properly made in sand, pointed to wide differences of opinion regarding what should be called a normal seedling. Further, some laboratories term seedlings normal when they show certain disease lesions because, under soil conditions unfavorable to the disease, the seedlings will continue development. Other laboratories term such seedlings abnormal.

It seems logical to term certain lesioned seedlings normal because they do survive under favorable soil conditions. Seed testing laboratories are quite unable to prophesy whether competition from heat, cold, drought, drowning, weeds or disease, will cause a seedling to fail to survive; hence the view that a normal seedling is one which possesses the capacity to produce a plant, even though disease is a different type of competition.

Procedures Used in Tests

Four samples of sweet clover were tested. Each was thoroughly mixed and a carefully drawn sub-sample sent to each of fourteen official

and eleven commercial laboratories. A questionnaire requesting information on methods used in each laboratory was sent to each laboratory along with the following directions for conducting the test:

"Enclosed are 4 sub-samples of Sweet Clover seed, designated 51-3953, 51-4458, 51-4713 and 51-5962. Please make a germination test of each of these, accurately following the instructions.

a. 2x100 Between wet blotters - blotters thoroughly soaked, and not allowed to drain.

b. 2x100 Between intermediate blotters - blotters thoroughly soaked,
y. 2x100 and drained until stream of water just starts to drip.

c. 2x100 Between damp blotters - blotters thoroughly soaked, and drained
z. 2x100 until all dripping has stopped.

d. 2x100 By your regular method.

Place a layer of moist blotters on a solid bottom tray. Place blotters containing seeds on above blotters. Do not cover any part of one test with any part of any other test, that is, have a single layer of blotter over the seeds. Operate germinator at 20°C constant.

Tests a, b and c; water daily to keep blotters at the original moisture content as closely as possible.

Tests x, y and z; do not water at any time.

Count at 5 days. Do not make a first count at 3 days. As sprouts are counted place them side by side on four damp blotters for each test. (Blotters may be small to save postage.) Blotter No. 1 - undoubtedly normal sprouts. Blotter No. 2 - doubtful sprouts counted as normal. Blotter No. 3 - doubtful sprouts counted as abnormal. Blotter No. 4 - undoubtedly abnormal sprouts. Cover sprouts with a damp blotter. Wrap blotters containing sprouts in waxed paper and send them to me, marking the package 'Sweet clover sprouts for research test.' Also please send me 6 dry blotters of the kind in use in your laboratory.

The differences in moisture level were designed to learn whether excess moisture invariably results in an excessive number of abnormal seedlings under the conditions obtaining in different laboratories.

The questions on method were designed to learn the differences in technique employed.

The count was made at 5 days instead of 3 and 6 in order to have the seedlings returned to Winnipeg for check to learn the differences of opinion regarding the evaluation of normal seedlings.

Many of the official laboratories were very busy testing seed for the enforcement of law and consequently some were unable to make the tests. Results were received from eight official and eight commercial laboratories.

Discussion

The answers to the questions revealed wide differences in technique between laboratories. These have been noted under paragraph (b) in the introduction. The differences in technique have been tabulated but it was not possible to detect any correlation between the variations in technique and the readings of the tests, so that this tabulation is not included in the report.

No attempt was made to apply the statistical analysis of variance nor the chi-square test for homogeneity. The purpose of the project was not to discover whether or not there are significant differences or

Table No. 1. - Summary No. 1 - Germination of Sweet Clover Seed
(All 16 laboratories)

Sample No.	Treatment							
	a	b	c	d	x	y	z	sand*
51-3953	%	%	%	%	%	%	%	%
Median	87	87	86.75	88.5	90	87.75	87.25	86.5
High	94.5	93.5	93	93	95.5	93	93	87
Low	65	68	69	78	68	68	76	84
Range	29.5	25.5	24	15	27.5	25	17	3
51-4458								
Median	80.5	80.5	80.25	82.25	80	81	81	80
High	86	87	85.5	88	85	92	89	84.5
Low	62	55	67	76	53	56	65	77
Range	24	32	18.5	12	32	36	24	7.5
51-4713								
Median	76.5	75	74	75.5	76.5	75	75	74.25
High	84	84	83	87	82	86.5	82	83.5
Low	46	55	61	67	51	54	51	74
Range	38	29	22	20	31	32.5	31	9.5
51-5962								
Median	62.75	63.75	64.75	65.25	65.5	63.25	65	59.5
High	69.5	74.5	71	74	74.5	76	76	60
Low	42	46	48	54	36	40	46.5	55.5
Range	27.5	28.5	23	20	38.5	36	29.5	4

For footnote, see page 22.

significant uniformity between laboratories but to attempt to ascertain why these occurred. For this purpose stating the approximate median, the range between the high and the low, and the difference between the median and the high and the low respectively, is deemed sufficient to disclose the general picture.

The mean average is not a reliable indication of the accuracy of germination tests when there is a wide range in results. The median is much more reliable, although it is always possible that the highest result is the most accurate, provided that the evaluation of normal seedlings has been accurate.

Summary No. 1 includes the results from all sixteen laboratories. It is plainly evident that there are significant differences between laboratories, the least range in the tests between blotters being 12% in test "d" of sample 51-4458, and the greatest range no less than 38.5% in test "x" of sample 51-5962. This summary fails to throw further light on the reason for these ranges.

Summary No. 2 includes the results from nine laboratories only, the results from seven laboratories being excluded. The reason for excluding the results from six of the seven laboratories was the failure to make an accurate separation of normal from abnormal seedlings. A number of broken cotyledons concealed by the hull were missed and the seedlings were counted as normal. The results from the seventh laboratory were excluded

Table No. 2. - Summary No. 2 - Germination of Sweet Clover Seed
(9 laboratories only)

Sample No.	Treatment							
	a	b	c	d	x	y	z	sand*
51-3953	%	%	%	%	%	%	%	%
Median	87	84.5	87	90	89	88	88	86.5
High	90	90	92.5	93	92	93	92	87
Low	82	83	84	85.5	80.5	87	85	--
Range	8	7	8.5	7.5	7.5	5	7	3
51-4458								
Median	78.5	80.5	81.5	82	80	77.5	79	80
High	82.5	85	85.5	87	85	85.5	87	84.5
Low	75	75	73.5	76	74.5	76	75.5	--
Range	7.5	10	12	11	10.5	9.5	11.5	7.5
51-4713								
Median	76	75	78	75.5	75	73.5	74.5	74.25
High	80.5	78.5	83	83.5	79.5	83.5	78	83.5
Low	75	69.5	67	73	69	68.5	73.5	--
Range	5.5	9	16	10.5	10.5	15	4.5	9.5
51-5962								
Median	62	63	62	61.5	61.5	61	62.5	59.5
High	68	66	69.5	68	68.5	70	70	60
Low	59.5	54.5	54	60	55	57	59	--
Range	8.5	11.5	15.5	8	13.5	13	11	4.5

*The sand test was made by 3 laboratories for 51-3953 and 51-4458, and by 4 laboratories for 51-4713 and 51-5962,

because, while an excellent evaluation of normal seedlings was made, the percentage of normal seedlings in all tests was consistently about 20% below the median. It was noted that a considerable number of the abnormal seedlings were badly diseased, and an inquiry directed to this laboratory disclosed that the divergence was caused by extreme variations in moisture, possibly coupled with zinc poisoning.

Contrary to the discouraging opinion expressed by several analysts, the attempt to mail seedlings as separated in the different laboratories was very successful indeed. In all but a very few cases they arrived in good condition and the differences in evaluation were readily noted. In the few cases where seedlings arrived in poor condition the blotters in which they were packed were too wet. Some analysts apparently feared that they would dry out in the one or two days required to reach their destination. Seedlings packed between slightly damp blotters were unchanged in appearance when unpacked.

An examination of Summary No. 2 discloses that the tests made in these eight laboratories are rather remarkably homogeneous as between laboratories. The range between the high and the low laboratory in each test is close in practically every case. The greatest range occurs in the low testing sample No. 51-5962 and is 15.5%. The medians of the series of tests on each sample are also very close. The medians of the sand tests

made by three or four of the laboratories are very close to the medians of the B. B. tests.

Summary No. 2 apparently gives evidence that differences in the moisture level of blotters have little effect on results. This conclusion, however, may be erroneous. The instructions stated that in no case was more than one thickness of blotter to cover the seeds. In Winnipeg it was noted that the weight of a single thickness of blotter was not sufficient to keep the seedlings from pushing the top blotter up, so that the enfolding action caused by piling up blotters did not occur. Quite possibly this separation of the blotters might be enough to prevent excessive wetting of the very young seedlings, and they were able to develop without regard to the original moisture level. If the original moisture level surrounding the seeds had been retained throughout the test the results might have been different.

Conclusions

Summary No. 2 presents evidence to show that it is quite possible to obtain uniform results between laboratories when similar technique is used.

Accurate and uniform results are not affected significantly by certain variations in technique but are affected severely by other variations in technique.

Investigations should continue into those factors in technique which adversely affect germination or which induce the occurrence of an excessive number of abnormal seedlings.

These factors should be described in the rules for making germination tests so that they will be avoided.

Checking of normal and abnormal seedlings presented evidence that some laboratories appear to have no clear concept of what constitutes a normal seedling because the separations were inconsistent.

It was evident that some laboratories clear too many seedlings in the preliminary count. Some sprouts which had just emerged from the seed coat when counted, and had been included in the normal seedlings, were clearly abnormal at the time they were checked. It was demonstrated that it is not possible in many cases to determine accurately whether a sprout is normal or not until it has been allowed to develop into a definite seedling.

It was evident that training of the eye is needed by some analysts. For example, broken cotyledons when covered by the hull, were missed.

In spite of the failure of the project to throw light on certain points hoped for, it is felt that progress has been made towards the more accurate description of a test which will evaluate capacity to produce plants.

Report for Region No. 3 - Northeast

by G. P. Steinbauer, Orono, Maine

Replies to a questionnaire circulated in the fall of 1941 indicated a wide range of interests and problems that the analysts in Region No. 3 felt worthy of consideration for referee and research work during the year. Unfortunately few of the analysts who suggested problems actually had at their disposal sufficient amounts of the seeds of the proper type to submit them for test. Several analysts suggested that projects should

be continued long enough to reach conclusions even though this might involve study of a single problem for more than one year.

Two tests were undertaken during the season. The first of these was carried out cooperatively with the subcommittee on sand tests. Ten laboratories in Region No. 3 took part in the tests. Plans for the tests, tabulation of results and conclusions were under the direct supervison of C. W. Leggatt and are covered in the report of the Subcommittee on Sand Tests and need not be reported here.

The second test dealt with the problem of separating normal and abnormal sprouts of timothy. It has been stated by some analysts that undue emphasis has been placed on classifying seedlings into normal and abnormal groups. The abnormal seedlings are of interest only insofar as they must be recognized and segregated from the normal seedlings that have a good prospect of developing into mature plants under favorable conditions. Unfortunately there is not always a sharp dividing line between these two groups. The judgment of the analyst, based upon practice and experience, must determine where this line shall be. The use of supplementary sand and soil tests, the use of drawings of normal and abnormal seedlings, and the use of photographs of types of seedling development are all helpful in making evaluation of seedlings in a germination test.

As a means of affording additional practice in evaluating normal and abnormal timothy seedlings two samples of timothy were subdivided and circulated for test. The first of these was taken from a commercial lot of seed showing high germination and few abnormal sprouts. The second sample was from low quality material showing various abnormalities. These were for the most part concerned with poor development of the primary root and stem tip. As an aid in interpretation of these seedlings diagrams of the principal abnormalities were sent along with the samples. The method of conducting the test was that suggested in the Rules for Seed Testing. Twelve laboratories participated in the tests.

A detailed report of the results of the test was sent to the participating laboratories. There was good agreement between laboratories relative to the germination of the high quality sample. Although there was excessive variation in interpretation of normal and abnormal sprouts in the low quality sample it is encouraging to note that the range was considerably less than observed in the previous year when a similar sample was tested by the same group of laboratories.

Several analysts expressed the opinion that the failure of the primary root to develop usually prevents the development of vigorous seedlings under field conditions even though a few root hairs may form at the base of the grain and adventitious roots later form at the base of the stem.

REPORTS OF SPECIAL COMMITTEES AND SUBCOMMITTEES

Report of Special Committee on Standardized Tests

The special committee appointed by the President of the Association to investigate the possibility of developing a series of uniform tests began its work late in 1940. The original plan for the committee was for four laboratories, including the Canadian Department of Agriculture and the Federal Laboratory in Washington, to make germination tests of a few samples independently and, if the results were too divergent, to have one laboratory replant the samples and at the time of the final count all four representatives would meet together, each make a separate estimate and then try to agree on a common basis of evaluation. Following that procedure the intention was for the Federal representative to send out replicate samples to each of several selected laboratories and arrange a planting schedule. Finally he would visit personally each cooperating laboratory on the day the final count was made and acquaint the local analyst with the method of evaluation agreed upon by the several members of the committee. By the above procedure it was hoped that, in time, a greater degree of uniformity might be developed. The Agricultural Marketing Service of the United States Department of Agriculture approved the basic plan but because of lack of funds was unable to provide for the laboratory visitation by one of its staff.

In 1941 the project carried forward consisted of tests by four laboratories of three samples of onion, two samples of sweet clover and one sample of flax in blotters and in sand. The results of these several tests were summarized and analyzed. The data showed that only with the flax sample were the normal sprouts in blotters in reasonably close agreement. In all other cases the differences between the four laboratories were significantly different, in four out of the six lots highly significant. The data from the sand tests showed that for three out of six lots the percentages of emergence obtained by the four laboratories were not significantly different. The classification of normal seedlings in sand gave uniform results in two out of six lots. The differences in sand for the other four lots were not as variable as those from the blotter tests.

In 1942, two samples of onion, and one each of sweet clover, alfalfa and flax were tested in blotters and in sand. Sand and blotters from the Iowa laboratory were supplied to each member of the committee and each in turn made additional tests using local sand and blotters. Seedlings were classified as normal, abnormal and questionable. In all there were ten blotter tests and ten sand tests, each with four replications.

As a whole the differences were far less divergent than in the previous year. In three out of ten tests in blotters the differences were significant, in two of the three the differences were highly significant. In the sand tests there were three out of the ten in which the differences were significant, in two of the three the differences were highly significant.

In general the uniformity in sand was considerably greater than in blotters because of the seven comparisons in which the differences were not significant each in blotters and sand the average probabilities were .14 for blotters and .46 for sand. The results suggest that sand offers a superior medium for the development of a standard procedure. There was no indication that the Iowa sand was superior or inferior to that used by each laboratory.

The results of the two years' work with four kinds of seed, together

with the differences in opinion exercised by many analysts as to what constitutes normal and abnormal seedlings and pure and impure seed has lead the committee to believe that there is need for unification of ideas and procedures. This need is also emphasized by the fact that the Canadian Department of Agriculture, the U. S. Department of Agriculture, through the Agricultural Marketing Service, and the Association of Official Seed Analysts constitute three agencies each with autonomy and authority to develop procedures and make rules and regulations for seed testing.

To coordinate the work of these agencies and to provide for an ultimate basis of agreement the committee makes the following recommendations:

(1) That its efforts to promote standardization and uniformity of methods for seed testing in seed laboratories be continued.

(2) That the membership of the committee be officially recognized as including at least one representative each from the Canadian and United States Departments of Agriculture, the chairmen of the Research and Rules Committees of the Association and one additional member from the Association at large to be appointed by the President. The chairman of the committee shall be appointed by the President to serve for a period of three years.

(3) That projects be those which have been carried to a reasonably satisfactory conclusion insofar as research is concerned but which offer promise of establishing uniform procedures in all laboratories.

(4) That from time to time the committee publish the results of its findings and present recommendations to the Association for the adoption of such procedures as it is believed are necessary to uniformity in seed testing. - R. H. Porter, Chairman, W. C. Pfaender, G. P. Steinbauer, and W. H. Wright.

Report of Committee on Qualifications

by W. H. Wright, Chairman

Qualifications for Official Seed Analysts and Necessary Equipment for Seed Analytical Work

Seed analysis for purity and testing for germination plays a very important part in inter-state and inter-national trade in seed, and are of vital importance to agriculture.

Persons in charge of laboratories and seed analysts require knowledge, skill and patience. Without properly trained personnel in the official laboratories it is impossible to maintain the necessary uniformity of technique and reporting on individual lots of seed which are shipped from place to place.

The Association of Official Seed Analysts, after careful consideration, has drawn up the attached statement of qualifications for analysts, and necessary equipment for the operation of efficient laboratories.

1. Because seed testing can fulfill its obligation to agriculture only if the work is on a sound scientific foundation which is based on a personnel with such training as will enable them to understand the broad significance of their work and to develop seed testing to meet changing conditions, therefore, this Association recommends the following as desirable minimum qualifications for those selected for positions in seed testing laboratories.

(a) Qualifications for those in direct charge of laboratories:
College graduation with broad foundation in biology, post-graduate

work or equivalent experience furnishing training in systematic botany, morphology, physiology, pathology, and statistical methods. These educational qualifications should be supplemented by a thorough knowledge of methods of seed testing and some acquaintance with the production and marketing of seeds.

(b) Qualifications for analysts carrying on the actual work of seed testing:

College training in biology with a good foundation knowledge of systematic botany, plant morphology, and either plant physiology or pathology. Some acquaintance with statistical methods is desirable. The actual training in seed testing methods at present is available, for the most part, only in properly manned and equipped seed laboratories.

2. The committee also recommends that the following be considered as absolutely minimum equipment for satisfactorily carrying on seed testing work:

Suitable quarters with adequate light, hand lens, binocular, seed herbarium, analytical and torsion balances, divider, blower, and germination chambers capable of being maintained at the temperature or temperatures required for the seed to be tested. In addition to the aforementioned equipment, all seed testing laboratories should have the use of a greenhouse. This is especially true in the testing of certain lots of seeds which show weak seedlings in the usual laboratory tests.

3. The following additional equipment is desirable in laboratories carrying on at least an average amount of work:

Compound miscroscope, diaphanoscope, light germinator, cold chamber for pre-chilling seeds and vacuum counter.

REPORT OF THE SUBCOMMITTEE ON HARD SEEDS

W. O. Whitcomb

Montana Agricultural Experiment Station, Bozeman, Mont.

The major portion of the time of this committee has been devoted to the preparation of "A Review of Experimental Results with Hard Seeds." This project was started as the result of a request which was made by the Association at the 33rd Annual Meeting at Ames, Iowa, in July 1941. A tentative list of literature dealing with hard seeds has been made. This list, which consists of 92 publications, has been submitted to a number of members of the Association with a request for criticisms and additions. It is hoped that we may be able to complete this work in the near future.

One paper which deals with the hard seed content of normal and discolored alfalfa seed has been prepared for publication in the Proceedings of this meeting and immediately follows:

CROP-PRODUCING VALUE OF DISCOLORED ALFALFA SEED IN MONTANA - 1941 CROP

CORRELATION OF LABORATORY AND FIELD TESTS[1]

For the Subcommittee on Hard Seeds

W. O. Whitcomb

Montana Agricultural Experiment Station, Bozeman, Montana

The fall of 1941 in Montana was wet during the harvesting season, and as a result much of the alfalfa seed in certain regions contained appreciable amounts of discolored seed. The question was frequently asked as to what effect this discoloration would have on the crop-production properties of the seed. It was to obtain some information which would help to answer this question that some experimental work was planned in the Montana seed testing laboratory.

MATERIALS AND METHODS

One hundred samples of the commercial lots of alfalfa seed, which had been received at the laboratory for routine testing, were selected. Random samples of normal and discolored seeds were separated from these by hand. The discolored seeds were exclusive of those of a green color and ranged from light brown plump to dark brown shriveled seeds.

The laboratory tests were made in the prescribed manner and the field tests were made by placing 100 seeds in rod rows, which were one foot apart. The field soil was in good condition at the time of planting, but later became rather dry. This caused the number of plants to be somewhat lower than is normally obtained under field conditions. The date of seeding was May 28th, and the date of counting the plants was August 1st.

In the laboratory studies, the characteristic germination defects of the discolored seeds were found to be; (1) broken sprouts, (2) heavy black mold, (3) abnormal sprouts which were stubby or twisted, (4) watery seeds, and (5) damping off. In the field tests, no weak or abnormal seedlings were observed.

EXPERIMENTAL RESULTS

The results of the laboratory and field tests, together with their coefficients of variability are given in Table 1. It will be noted that the means for the data from all of the tests are considerably higher for the normal seeds than for the discolored seeds, and that the coefficients of variability are correspondingly lower.

Weight per 100 Seeds - The mean weight of 100 normal seeds was 202.8 milligrams, while that of the discolored seeds was 183.2. This weight of the discolored seed was more variable as shown by the coefficient of variability of 14.9% as compared with that of 13.4% for the normal seeds. In making the distribution tables of the weights of these two classes of seeds, it was noted that a larger proportion of the samples of the normal seeds fell in the group having a weight of 180 milligrams or more, while with the discolored seeds the larger proportion had a weight of less than 180 milligrams.

---

1. Contribution from Montana State College, Agricultural Experiment Station. Paper No. 171, Journal Series.

Table 1. - Comparative laboratory and field data for normal and discolored alfalfa seed.

Characteristics studied	Normal colored seed		Discolored seed	
	Mean	Coefficient of variability	Mean	Coefficient of variability
Weight per 100 seeds in milligrams	202.80 ± 1.833	13.40	183.20 ± 1.841	14.90
Laboratory germination, percentage	71.95 ± .888	18.29	42.90 ± .969	33.47
Hard seeds, percentage	19.55 ± .879	66.65	7.60 ± .428	83.42
Laboratory germination plus hard seed percentage	91.86 ± .345	5.57	50.72 ± 1.137	33.24
Plants in field, percentage	35.05 ± .626	26.48	15.96 ± .500	46.49

Laboratory Germination and Hard Seeds - The mean laboratory germination of the normal colored seeds was 71.95% as compared with 42.90% for the discolored seeds, a much greater viability for the former. The coefficients of variability of 18.29% and 33.47% showed the germination of the discolored seeds to be much more variable than that of the normal seeds. The germination of the normal colored seeds ranged from 35% to 98%, while that of the discolored seed was from 5% to 74%.

The hard seed content of these two classes of seeds was of special interest. As might be expected, the hard seed content of the normal colored seeds was more than twice as great as that of the discolored seeds, the two means being 19.55% and 7.60%, respectively. The variability in both cases was very high, being 66.65% for the normal seeds and 83.42% for the discolored. The range in percentage of these hard seeds was from 0 to 69 for the normal seeds and from 0 to 34 for the discolored.

When the percentages of hard seeds of the various samples under study were added to the respective germinations, the variability was much reduced, the coefficients being 5.57% for the normal seed and 33.24% for the discolored seed. The sums of the mean germination and hard seeds were 91.86% for the normal seed and 50.72% for the discolored.

Field Germination - The mean germination of the normal seed in the field tests was 35.05% as compared with 15.96% for the discolored seed. The variability in both cases was high, being 26.48% and 46.49%, respectively. The low germination in both cases was apparently due to the soil drying out about three weeks after the seeds were planted, but it is worthy of note that the normal colored seed produced over twice as many plants as did the discolored seeds. It is also significant that the relative germination of these two classes of seeds in the field were in keeping with their germination percentages in the laboratory. This will be further emphasized in the correlation studies which are to follow.

Comparison with Previous Results - These laboratory and field tests show higher percentages for discolored seeds than those reported by

Whitcomb[1] in 1921. At that time the brown seeds averaged 25% germination with 3% hard seed in the laboratory and 4% germination in the field. The normal seeds germinated 79% with 16% hard seeds and 31% in the field.

CORRELATION STUDIES

The correlation coefficient may well be defined as a measurement of the degree in which two characters of a group of several lots of seeds tend to be associated in value. This presupposes that the characters are of such a nature that they may be dependent one on the other, and that the seeds are of the same kind. A perfect positive correlation coefficient is + 1.000 and indicates that the two characters move in the same direction to the same degree. A perfect negative correlation coefficient is -1.000 and indicates that the two characters move in the opposite direction and to the same degree. In working with germination of seeds, we do not find perfect correlations, but rather ones of the order of + .2000 to + .900, or in some cases small negative coefficients are obtained.

In Table 2 are given the correlation coefficients for five relationships of characters for both normal and discolored seeds of alfalfa.

TABLE 2. - Correlation between certain characters of alfalfa seed. Comparison of normal and discolored seed.

Characteristics correlated	Correlation coefficients	
	Normal colored seeds	Discolored seeds
1. Weight of 100 seeds with laboratory germination	-.004 ± .067	.282 ± .062
2. Weight of 100 seeds with hard seeds	.210 ± .065	-.112 ± .067
3. Weight of 100 seeds with plants in field	.441 ± .055	.289 ± .062
4. Laboratory germination with plants in field	.493 ± .051	.661 ± .038
5. Laboratory germination plus hard seeds with plants in field	.230 ± .064	.680 ± .036

It will be noted that two of these coefficients are negative and that the others are positive. The two negative coefficients are so small as not to be significant, while the positive ones are large enough to be considered as having varying degrees of significance.

From these correlation coefficients in Table 2, the following conclusions are drawn relative to the relationship of the results of certain tests on these two groups of seed under consideration:

1. Laboratory germination of discolored seed was somewhat dependent upon the weight of seed, but for the normal seed it was not.

2. Hard seeds were somewhat associated with the havier seeds in the normal group, but not in the discolored group.

3. There was a good relationship between percentage of plants produced in the field and the weight of the seeds in both the normal and discolored groups.

4. There was a good relationship between the percentage of plants produced in the field and the laboratory germination without the hard seeds. This relationship was more pronounced with the discolored seeds than with the normal seeds.

1. Whitcomb, W. O. Relative value of green and ripe seeds in alfalfa and sweet clover. Proc. Assoc. Off. Seed Anal. 1921: 37-40. 1923.

5. When the hard seeds were added to the laboratory germinations, the relationship of these totals was somewhat less with the plants in the field in the case of normal seeds, but more with discolored seeds. This would seem to indicate that the hard seeds in the discolored group responded more readily to germination conditions in the field than did those in the normal group.

Comparison with Previous Results in Correlation Studies - The correlation coefficients given in Table 2 are somewhat more variable than those reported by Whitcomb[1] for alfalfa in 1937. This can probably be accounted for in part by the difference in the nature of the seeds and the varying conditions under which the field tests were made.

SUMMARY AND CONCLUSIONS

A study was made of the relative crop producing value of normal and discolored seeds separated from 100 lots of 1941 crop of Montana alfalfa. The results obtained in the laboratory and field are briefly summarized as follows:

1. The mean weight per 100 seeds of the normal seeds was 202.8 mg and that of the discolored seeds was 183.2 mg.

2. The mean laboratory germination of the normal seeds was 71.95% and that of the discolored seeds was 42.90%.

3. The mean percentage of hard seeds was 19.55 in the normal seeds and 7.60 in the discolored seeds.

4. The normal seeds produced 35.05% plants in the field as compared with 15.96% for the discolored seeds.

5. From the correlation studies which were made the following conclusions were drawn:

   a. The weight per 100 seeds was associated with the laboratory germination for the discolored seeds, but not for the normal seeds; it was associated with the hard seeds in the normal seeds; and with the plants produced in the field for both the normal and discolored seeds.

   b. There was a good relationship between the laboratory germination and the plants produced in the field for both the normal and the discolored seeds.

   c. The sum of the hard seeds and the laboratory germination, when correlated with the plants in the field, showed a different relationship from that of the germination alone. This was higher for the discolored seeds, but lower for the normal seeds.

6. In general, it may be concluded from this study that discolored seeds of alfalfa, which have a brown appearance, may have about half the crop-producing value as do the normal colored seeds.

1. Whitcomb, W. O. Hard seed in legumes: Correlation between laboratory and field germination. Proc. Assoc. Off. Seed Anal. 1937: 138-145. 1938.

REPORT OF THE SUBCOMMITTEE ON METHODS FOR THE ANALYSIS OF SMALL SEEDS[1]

Louisa A. Kanipe

Oregon State College, Corvallis, Oregon

Only one project was initiated by the committee for this season's study because the pressure of war work has been felt by all laboratories. This left for another time the suggestion by the former committee that a further study of the problems involved in testing orchard grass seed, the use of blowers, and allied studies be made. The problem selected was to consider the effect of the size of the working sample in analyses of bentgrasses and red top seed.

In 1938, Referee Region No. 2 carried out a carefully planned experiment to compare tests on two subsamples (nearly one-half gram in weight) with the calculated analysis of their total, which would represent a one gram sample. Their results showed differences greater than expected from a homogeneous lot of seed. This variability was attributed to the composition of the subsamples as separated by a mechanical divider.

Data from 108 lots of redtop seed, divided in a similar manner and without replicates, were available to the committee but were not included in this report. They had a pure seed content ranging from 77.2% to 98.7% with an average quality of 90.4%. Each of these samples had a one gram portion divided into two parts which were analyzed separately. These duplicate analyses showed differences in pure seed percentages which ranged from 0.02% to 3.61%. The average difference was 0.93%. These data are very interesting in showing the variation that occurs when using two one-half gram portions, but no data were available to show the variation when using two one gram portions from the same seed. Therefore, no valid conclusions as to the effect of the size of sample alone could be drawn from this material.

Procedure

For the current referee problem, two samples of bentgrass seed grown in Oregon, and two of redtop grown in Illinois and furnished by W. F. Cameron were sent to the cooperating laboratories with a request that they follow a uniform method of procedure in obtaining the subsamples for testing. This method consisted of running the sample through a divider several times in order to distribute the seeds evenly, splitting the bulk sample with a mechanical divider until a portion approximately the desired weight was obtained, weighing this subsample to four significant figures, repeating the operation until five subsamples from the bulk were obtained for weights of one-half gram and one gram. The method for two gram samples varied in that each purity separation was thoroughly remixed with the bulk before another two grams was divided. This helped to maintain the composition of the material. Five replicates of each weight were requested to help control so-called "experimental error." Each subsample was requested to be drawn from the remaining bulk as an aid in avoiding any possible limiting factor caused by distribution within the bulk. Three weights were

---

1. The Chairman desires to express sincere appreciation for the response from the following cooperating laboratories:

R. H. Porter, Ames, Iowa
A. Hope, Sackville, N. H.
W. H. Wright, Ottawa, Ont.
W. A. Davidson, Washington, D. C.
Bette Cullinan, Geneva, N. Y.
C. W. Leggatt, Ottawa, Ont.
Regina Schulte, Lafayette, Ind.
G. P. Steinbauer, Orono, Maine
Betty G. Sanborn, Durham, N. H.

Especial thanks are extended to C. W. Leggatt for his hours of work in preparation of the statistical analyses and excellent suggestions on the results.

suggested in order to check the comparative effect of the size of sub-samples.

Bulks were selected which apparently were free of weedy species of Agrostis. Therefore, in making the purity separation, all Agrostis spp. were placed in the pure seed fraction regardless of their external appearance; that is, all seed retaining the glumes (complete florets), seed retaining the lemma and palea, and naked caryopses. Other material found was classed as other crop seed, inert matter, or weed seed. The segregations were weighed to four significant figures and the percentages calculated from the final weights.

Results

The program as outlined could not be completed by all participating laboratories. The number of laboratories reporting for the various kinds of seed and sizes of working samples are shown in Table 1.

TABLE 1. - Number of Laboratories Reporting on Agrostis Referee Samples

Kind	½ gram	1 gram	2 gram
A. alba (1)	4	4	2
A. alba (2)	4	4	2
A. tenuis	10	10	6
A. palustris	5	5	2

The detailed results of all the analyses made by the various laboratories were too lengthy for publication. C. W. Leggatt has kindly combined them into tables for the summation and statistical analysis. The results based on the mean values for the pure seed are presented in Tables II to IV. These tables can probably best be studied by first examining their headings.

Column headings

Mean - This is the average of the individual analyses made by each laboratory.

Range - This is the difference between the highest and lowest pure seed content within the percentages of each laboratory.

Number of analyses - This is the number of replicates used.

Homogeneity test P values - This shows whether the tests theoretically are homogeneous for the lot of seed.

Index of Variability - This represents the aggregate of differences for each kind of seed.

Row headings

Average - This is the mean of the numbers listed immediately above.

Range - The first number is the difference between the highest and lowest value in the mean percentage of pure seed (listed above). The second number or Extreme Range (replicates) is the greatest difference shown in all the single tests made by all the laboratories. The Summation of x^2 gives a value which indicates the homogeneity when all the tests are surveyed as a group.

The results from the analysis of one-half gram samples are given in Table 2. The original data contained one replicate from Laboratory No. 5 which had pure seed percentage of 96.68%. This was clearly out of line and

it is unlikely that such an extreme distribution would reoccur. For this reason, all the tables have been made to show the statistical analysis both when this test was excluded and when it was included. The figures in parentheses in the tables represent the values when this test was included.

When the one extreme test is omitted, Row 2 shows that the range for both Agrostis palustris and Agrostis tenuis is narrower than for the two samples of Agrostis alba. This is probably a reflection of the difference in pure seed content of the original bulks. The two bentgrass seed samples were over 97% pure seed while the two redtop samples were 92% and 94% respectively. The index of variability was .98 and .90 for the bent grasses as compared with 1.57 and 1.37 for the redtop. The significance of these figures is more pronounced when they are compared with the results of the one and two gram samples recorded in Tables 3 and 4.

The results from the one-gram samples as given in Table 3 show a narrower range of mean purity values than those from the one-half gram samples. With the one-gram samples there appears to be no consistent different between kinds of seed. The index of variability (Table 3, Column 5) was higher for both bents and redtop than when one-half gram was used. The test for homogeneity shows four laboratories to have excessive variation within their replicates. Agrostis tenuis and Agrostis alba (2) further have excessive variation when the analyses are considered as one group as shown by ΣX^2 (Table 3, Row 2).

The range between analyses when two grams were used (Table 4, Row 2) is narrower than for either one-half or one-gram showing that the larger quantity analysed, the nearer the absolute quality of the bulk is approached. As with the one-gram, however, lack of homogeneity within laboratories and between laboratories is apparent. The index of variability (Table 4, Column 5) is not consistant for species. When viewing the two-gram table it must be remembered that the results are based on a smaller number of analyses than the other two sizes of samples.

DISCUSSION

What do these data mean as applied to our problem? The consideration of sizes for working samples has been ably expressed by Dr. Leggatt when he wrote, "The object of the mechanical operations involved in seed analysis is to arrive at a statement of analysis which represents, as accurately as is practicable, the true quality of a bulk of seed. The latter could, of course, only be known by an analysis of the entire bulk; thus a working sample must be regarded as a compromise designed to provide the best practical estimate of a true quality." Thus, our problem is to ascertain what size of sample is most practicable, or more specifically, if one-half gram will give a satisfactory value for the lot of seed under consideration.

Dr. Leggatt stated further, "A point that is absolutely fundamental and which should be clearly grasped is that the size of a sample of seed, from the analyst's point of view, depends not on its weight or bulk, but upon the number of seeds contained in it. This is the basis upon which, largely, the quantities laid down for analysis in the Rules for Seed Testing are determined." The weights listed in the Rules and Regulations for the Association have been established, with a few exceptions, on an analysis of approximately 3,000 seeds. Bentgrass and redtop are exceptions since they average about 18,000 and 11,000 seeds respectively to the gram.

For ease of interpretation the results from Table 2 to 4 have been combined in Table 5. Here again the values in parentheses were obtained by

TABLE 2. - Results of the Analysis of One-Half Gram Samples of Agrostis by Various Laboratories

Lab. No.	Mean	Range %	No. of analyses	Homogeneity test; P	X^2/n (Index of variability)
Agrostis alba[1]					
1	91.59	1.06	5	.34	
2	92.18	0.92	5	.46	
3	91.51	0.70	3	.34	1.574
4	92.80	1.42	5	.02	
Average	92.08	1.06		.29	
		Extreme (Replicates)			
Range	1.29%	2.32	(ΣX^2)	.08	
Agrostis alba (2)					
1	94.67	0.71	5	.45	
2	94.11	1.34	5	< .01	
3	93.47	0.39	3	.71	1.375
4	94.63	0.57	5	.76	
Average	94.30	0.79		.48	
		Extreme (Replicates)			
Range	1.20%	1.77	(ΣX^2)	.16	
Agrostis tenuis					
1	98.02	0.46	5	.19	
2	97.93	0.29	5	.58	
3	97.91	0.27	3	.20	
4	98.36	0.19	5	.79	
5	97.67	0.17 (1.38)	5	.05 (<.001)	
6	97.89	0.33	4	.45	0.980
7	97.85	0.63	5	.04	(2.229)
8	98.11	0.26-	5	.66	
9	98.04	0.34	5	.51	
10	98.62	0.16	5	.92	
Average	98.05	0.31(0.44)		.48(.43)	
		Extreme (Replicates)			
Range	0.95%	1.27(2.01)	(ΣX^2)	.50(<.0001)	
Agrostis palustris					
1	97.27	0.69	5	.17	
3	97.19	0.20	3	.80	
4	97.53	0.42	5	.51	0.906
2	97.28	0.40	5	.70	
9	97.43	0.55	5	.43	
Average	97.35	0.47		.52	
		Extreme (Replicates)			
Range	0.34%	0.73	(ΣX^2)	.57	

TABLE 3. - Results of the Analysis of One Gram Samples of Agrostis by Various Laboratories

Lab. No.	Mean	Range %	No. of Analyses	Homogeneity test; P=	X^2/n (Index of variability)
Agrostis alba[1]					
1	91.93	0.73	5	.34	
2	92.06	0.49	5	.51	
3	91.96	1.45	3	<.01	
4	92.43	0.58	5	.50	1.934
Average	92.11	0.74		.34	
		Extreme (Replicates)			
Range	0.50%	1.45	(ΣX^2)	.02	
Agrostis alba (2)					
1	94.13	0.29	5	.89	
2	94.09	0.89	5	.08	
3	93.38	1.62	3	<.001	2.527
4	94.24	0.39	5	.77	
Average	94.02	0.71		.44	
		Extreme (Replicates)			
Range	0.86%	2.02	(ΣX^2)	<.01	
Agrostis tenuis					
1	97.99	0.43	5	.05	
2	97.91	0.42	5	.09	
3	97.83	0.42	3	.02	
4	98.17	0.26	5	.34	
5	97.97	0.50	5	<.01	
6	97.97	0.23	5	.47	2.324
7	97.82	0.28	5	.31	
8	98.06	0.25	5	.43	
9	98.04	0.71	5	<.01	
10	98.63	0.24	5	.71	
Average	98.05	0.37		.24	
		Extreme (Replicates)			
Range	0.81%	1.18	(ΣX^2)	<.0001	
Agrostis palustris					
1	97.71	0.28	5	.65	
3	97.23	0.58	3	.02	
4	97.58	0.26	5	.68	
2	97.35	0.33	5	.59	1.580
9	97.59	0.64	5	.02	
Average	97.51	0.40		.49	
		Extreme (Replicates)			
Range	0.48%	0.89	(ΣX^2)	.06	

TABLE 4. - Results of the Analysis of Two Gram Samples of Agrostis by Various Laboratories

Lab. No.	Mean	Range	No. of analyses	Homogeneity test; P =	X^2/n (Index of variability)
Agrostis alba[1]					
2	91.95	0.59	5	.17	
4	92.34	0.40	5	.54	1.205
Average	92.15	0.50		.36	
		Extreme (Replicates)			
Range	0.39%	0.91	(ΣX^2)	.29	
Agrostis alba[2]					
2	94.09	0.95	5	<.01	
4	94.50	0.53	5	.06	3.585
Average	94.30	0.74		.03	
		Extreme (Replicates)			
Range	0.41¼	1.17	(ΣX^2)	<.01	
Agrostis tenuis					
2	97.95	.39	5	<.01	
4	98.16	.12	5	.79	
6	97.98	.16	5	.34	
7	98.10	.35	5	<.01	2.381
8	97.99	.18	2	.07	
10	98.89		1		
Average	98,08	.25		.24	
		Extreme (Replicates)			
Range	0.94%	1.14	(ΣX^2)	<.01	
Agrostis palustris					
2	97.46	0.41	5	.06	
4	97.55	0.26	5	.43	1.621
Average	97.51	0.34		.25	
		Extreme (Replicates)			
Range	0.09%	0.41	(ΣX^2)	.12	

retaining the one statistically extreme value obtained by Laboratory No. 5.

Column headings:

Mean of Means - Each station did some five tests which gave a mean. This column is the average of these.

Range of Means - This is the difference between the highest station mean and the lowest and represents the maximum difference between laboratories.

Extreme Range (Replicates) - This is the difference between the highest single replicate and the lowest in the whole series for the given species and quantity analysed.

Mean Range - This is the average for all laboratories of the difference between the highest and lowest test in each.

Homogeneity - Mean P. These values are simply the averages of the values of P given by each station. They cease to be valid as values of P themselves because P cannot be averaged in this way, but they do serve to illustrate the relative uniformity.

TABLE 5. - The Summary of Statistical Data on Agrostis

Kind of seed	Mean of means	Range of means	Extreme range (Replicates)	Mean range	Homogeneity		Index of variability
					Mean P	ΣX^2	
One-half grams analyzed							
A. alba (1)	92.08	1.29	2.32	1.06	0.29	0.08	1.573
A. alba (2)	94.30	1.20	1.77	0.79	0.48	0.16	1.375
A. tenuis	98.05	0.95	1.27 (2.01)	0.31 (.44)	0.48(.43)	0.50(<.0001)	0.980(2.229)
A. palustris	97.35	0.34	0.73	0.47	0.52	0.57	0.906
Average		0.95	1.52 (1.71)	0.66 (.69)	0.44(.43)		1.209(1.521)
General						<0.19(<.001)	1.138(1.687)
One-gram analyzed							
A. alba (1)	92.11	0.50	1.45	0.74	0.34	0.02	1.935
A. alba (2)	94.02	0.86	2.02	0.71	0.44	< 0.01	2.527
A. tenuis	98.05	0.81	1.18	0.37	0.24	< 0.0001	2.324
A. palustris	97.51	0.48	0.89	0.40	0.49	0.06	1.580
Average		0.66	1.39	0.56	0.38		2.092
General						< 0.0001	2.134
Two-grams analyzed							
A. alba (1)	92.15	0.39	0.91	0.50	0.36	0.29	1.205
A. alba (2)	94.30	0.41	1.17	0.74	0.03	<0.01	3.585
A. tenuis	98.08	0.94	1.14	0.25	0.24	<0.01	2.381
A. palustris	97.51	0.09	0.41	0.34	0.25	0.12	1.621
Average		0.46	0.91	0.46	0.22		2.198
General						<0.001	2.238

TABLE 6 - Average range between means of laboratories

Amount	Range	Proportions	
		Exp.	Obs.
½ gram	0.95	2.0	2.06
1 gram	0.66	1.4	1.43
2 grams	0.46	1.0	1.00

TABLE 7 - Average mean range within laboratories

Amount	Range	Proportions	
		Exp.	Obs.
½ gram	0.66(0.69)	2.0	1.43(1.50)
1 gram	0.56	1.4	1.22
2 grams	0.46	1.0	1.00

ΣX^2 - These are the true values of P obtained by summing chi-square and degrees of freedom. They merely indicate whether or not the results can be be considered as coming from a homogeneous population.

Row headings:

Mean - This is the simple, arithmetic mean of the four values immediately above in each case, representing a sort of generalized average for each quantity analyzed for all species.

General - The two values in this row result from summation of chi-square and degrees of freedom. The first of these under the column headed ΣX^2 is not very helpful because the values of P are so small, except that it indicates that, in general, the variability was excessive for two sizes.

The relative variability is found in several ways. The ΣX^2 test for the homogeneity of the results for the three sizes of sample (Table 4, Row 2) are .19, <.0001 and <.001 and their indexes of variability are 1.14, 2.13, and 2.24 respectively. Both of these sets of numbers show that there is markedly less relative variation in the one-half gram samples than in either of the other two sizes. It has been suggested that this may be caused in part because it is easier to do consistent, meticulous work on a smaller amount of seed; also, that it may reflect the more detailed weighing as the one-half grams more weighted to ten-thousandths of a gram as compared with one-thousandths of a gram for the larger working samples. In the test for homogeneity the variation was excessive for both one-gram samples and two-gram samples for Agrostis tenuis and Agrostis alba (2). One interpretational factor that may account to some extent for excessive difference in the Agrostis tenuis samples is in the amount of Poa seed found. This bulk contained approximately .08% of caryopses of Poa that were overlooked by six out of ten laboratories making the tests.

The absolute variability can be more easily examined when segregated into the small tables numbered 6 to 8. Between laboratories the variability for one-half gram is about twice, and for one gram 1.4 times that for two grams which is what would be expected theoretically. Within laboratories (Table 7) the variability for the one-half gram is less than expected being 1/5 (instead of 2) and for one gram 1.2 times that for the two grams.

TABLE 8. - Mean Extreme Range (Replicates)

Amount	Range	Proportions	
		Exp.	Obs.
½ gram	1.52 (1.71)	2.0	1.67 (1.88)
1 gram	1.39	1.4	1.53
2 grams	0.91	1.0	1.00

The extreme ranges (Table 8) are 1.7 and 1.5 to 1 showing again that the relative variability is less than expected on the smaller samples. However, since twice as much variation is expected in the one-half gram as in the two grams and 1.4 times as much in the one gram, it is apparent that the true, or absolute, variation is still considerably greater for the smaller size. In this way the advantage gained by the lesser relative variability became minimized as the actual results would have a wide range in the smaller sizes or working samples.

Of four samples analyzed only the Agrostis tenuis has a sufficient

number of analyses for the result to be given great weight. The extreme ranges for this kind of seed (Column 3, Table 5) are 1.27, 1.18 and 1.14 for the three sizes. This shows comparatively little advantage in the extra time expended in testing an amount larger than 1/2 gram. It should also be noted, however, that as the number of seeds per unit weight and the percentage of pure seed decrease this variation would be expected to increase.

CONCLUSIONS

The conclusions to be drawn from these more or less complicated data might be listed as:

First - The relative variability for size of samples is practically that theoretically expected, or in some cases even less.

Second - Since the absolute variability is greater for smaller sizes of samples, part of the advantage gained by increased accuracy on small amounts is loss.

Third - Variation between laboratories was somewhat excessive on the two larger sizes of samples.

Fourth - One-half gram appeared to be of sufficient size for the Agrostis tenuis sample.

Fifth - There are insufficient results for a definite recommendation for size of working sample for the Agrostis palustris and Agrostis alba.

REPORT OF THE SUBCOMMITTEE ON PHYTOPATHOLOGICAL TECHNIQUE

W. D. Day

State Department of Agriculture, Sacramento, Cal.

Chemical control of molds and bacteria on cucurbit seeds

The seedlings of most species of the family Cucurbitaceae are extremely susceptible to damping off due to Pythium de baryanum Hesse, P. ultimum Trow, Phytophthora spp. and Rhizoctonia solani Kuhn. It has been difficult to secure a stand of cucumbers or muskmelons in soils inhabited by the fungi mentioned above. Recently, however, seed treated with Ceresan (ethyl mercuric chloride), Cuprocide (red cuprous oxide), Spergon (tetra-chloro benzoquinone), Semesan (hydroxymercurichlorophenol) and Thiosan (tetra methyl thiuram disulfide) have produced fine stands in damping-off sick soils.

Chemically treated seeds will become increasingly common in seed laboratories. Growers and dealers who realize the advantages of applying chemicals to seeds will also request that laboratory tests be made on seeds protected by some fungicide. It is advisable for every seed testing laboratory to be able to answer this demand and to become acquainted with several fungicides.

The objects of the study conducted by the subcommittee on phytopathological technique during the past year were: (1) to demonstrate the decay of seeds and sprouts by Rhizopus nigricans Ehr., Penicillium spp. and Bacillus carotovorus Jones, (2) to compare the efficiency of several

chemicals in controlling these organisms and (3) to determine phytotoxic effect of the chemicals.

Each member of the subcommittee was sent treated seeds of mixed cucumber, mixed muskmelon, Connecticut field pumpkin, green hubbard squash, summer crookneck squash, and summer straightneck squash. The fungicides used were: as dips, a 0.10% suspension of New Improved Ceresan (ethyl mercuric phosphate) and a 0.75% suspension of American Cyanamid Chemical Corporation 154-6B (betachlorethylethoxymercury-hydroxide); as dusts, Ceresan (2% ethyl mercuric chloride), Thiosan (tetra methyl thiuram disulfide, Cuprocide (red cuprous oxide), U.S.R. #601 (diluted to 5% organic formaldehyde) and U.S.R. #601 (diluted to 4% organic formaldehyde). The seeds were treated by shaking with an excess of dust for 2 minutes and then removing all excess material, or by soaking in a large volume of the dip suspension for 60 seconds followed by draining and drying.

The individual seeds lots were composed of 22 to 90 uncontaminated seeds and 2 to 10 seeds which had been exposed to lethal temperatures and then soaked in a mold spore suspension prior to treating. All tests were exposed to alternating temperatures of 30°C day and 18 to 20°C night. Folded paper towels were used for germination substrates. Specific directions concerning the original moisture content of the towel and frequency of additional watering were not given and it is likely this environmental factor varied between laboratories. All tests were studied and data recorded after a preliminary and final period as outlined in the Rules and Regulations for Seed Testing adopted by the Association of Official Seed Analysts.

Since the data recorded for the preliminary readings are not particularly informative they will not be presented in detail. A slight degree of chemical injury was noted by one collaborator in the preliminary observations. Red cuprous oxide produced a retardation in development of the root tips accompanied by a noticeable twisting. Rhizopus nigricans was recorded by all collaborators as present on the untreated lots. A very few tests of New I. Ceresan- and red cuprous oxide-treated seeds started to mold during the preliminary germination period. The percentage of normal sprouts recorded for this period indicated only that red cuprous oxide delays germination significantly.

The data as presented in Tables 1 and 2 are averages computed from

TABLE 1. - Chemical Control of Mold Fungi on Seeds of Cucurbits when Germinated in Paper Towels

Treatment	Germinants %						Seeds or seedlings, % contaminated with or rotted by:								
	Normal			Abnormal			Black mold			Blue or green mold			Bacteria		
	C (1)	M (2)	S (3)	C	M	S	C	M	S	C	M	S	C	M	S
Ceresan	77	73	60	6	6	28	0	0	3	0	0	0	0	5	1
Thiosan	75	71	68	8	6	22	2	0	0	0	T	0	1	2	2
601, 1 to 2	78	78	65	5	5	26	0	0	19	0	0	0	0	3	3
601, 1 to 3	71	76	66	8	3	26	T	3	3	0	T	0	T	9	5
Red Cop. Ox.	66	62	62	11	16	33	0	0	0	1	0	0	2	5	1
N.I.C.	68	76	60	10	4	28	11	18	18	0	1	1	2	8	11
154-6B	73	-	62	6	-	18	0	-	1	0	-	0	2		7
Check	71	71	54	5	6	26	45	46	18	1	2	15	3	14	16
Check	70	-	64	6	-	18	39	-	32	1	-	3	5	-	16

1. C means cucumber 2. M means muskmelons. 3. S means Summer Straightneck squash.

TABLE 2. - Chemical Control of Mold Fungi on Seeds of Cucurbits when Germinated in Paper Towels

Treatment	Germinants %						Seeds or Seedlings, % contaminated with or rotted by:								
	Normal			Abnormal			Black mold			Blue or green mold			Bacteria		
	P (1)	G (2)	S (3)	P	G	S	P	G	S	P	G	S	P	G	S
Ceresan	-	-	46	-	-	7	-	-	6	-	-	1	-	-	8
Thiosan	-	67	-	-	5	-	-	0	-	-	1	-	-	7	-
601, 1 to 2	-	-	43	-	-	10	-	-	8	-	-	0	-	-	11
601, 1 to 3	79	-	-	5	-	-	3	-	-	3	-	-	8	-	-
Red Cop. Ox.	-	-	29	-	-	30	-	-	6	-	-	2	-	-	7
N.I.C.	-	56	-	-	7	-	-	36	-	-	32	-	-	13	-
Check	80	63	40	0	4	6	35	42	47	3	38	11	13	36	24

1. P means Connecticut field pumpkin 2. G means hubbard squash 3. S means summer crookneck squash

the final readings of three collaborators. As mentioned above, the moisture content of the towels probably varied among laboratories so that the degree of molding and seedling decay differed in the tests conducted by these collaborators. The material Thiosan or 1205FF gave the highest degree of mold control and of bacteria inhibition. Chemical injury for this dust was practically nil. In view of the fact that Thiosan was recently introduced as a replacement fungicide for the mercurials it should be substituted for Ceresan and New I. Ceresan whenever possible. Although this study was not designed to demonstrate the control of damping off, Thiosan is known to be an excellent protectant for this purpose. Being only slightly soluble in water its protective action is lasting while that of the ethyl mercurials is very evanescent. When the germination period is lengthened the superiority of Thiosan becomes more apparent.

Red cuprous oxide while highly fungicidal is relatively phytotoxic. Chemical injury is negligible in well watered soil tests but frequently occurs with seedlings of most plant species germinated in paper towels.

The mercurials, Ceresan, New I. Ceresan, and 154-68 are among the most effective fungicides. In this study the active ingredients were diluted somewhat to prevent phytotoxicity. When used at slightly greater concentrations these materials will eliminate all mold growths.

U.S.R. #601 is a non-metallic dust and its use should be encouraged to conserve copper and mercury. Even when diluted with 2 or 3 parts of talc or flour it is a relatively efficient fungicide. When applied at full strength it completely eliminated mold growth but produced distinct chemical injury.

Your committee does not offer this report as a complete discussion on the control of molds and fungi on cucurbits. It does indicate, however, that certain chemicals provide suitable control with a minimum of phytocidal injury when properly applied.--W. D. Hay, Chairman; Willard L. Crosier; W. N. Rice; C. H. Amick.

REPORT OF THE SUBCOMMITTEE ON RANGE GRASS SEED STUDIES

Elva L. Norris and Anna E. Decker

Kansas State College, Manhattan, Kansas

The subcommittee on range grass seed studies presented its first report in 1941. There is much interest at the present time in the control of soil erosion and numerous investigations have been conducted in order to determine the grasses which are most suitable for this purpose. It has been generally agreed that the native climax grasses of a given region are best suited for reseeding purposes in the Great Plains Region. As a result of this conclusion, large quantities of native grass seed are being demanded. The research on the germination of native grasses is largely of recent date. Several research workers are now in the field.

American seed testing laboratories base the value of any grass seed on the percentage of caryopses producing sprouts. It is a well known fact that many native grasses exhibit delayed germination. They require an after ripening period before a satisfactory germination can be obtained. Some species appear to emerge from dormancy and at a later date enter a second period of dormancy. One can readily see that the testing of native grasses offers difficulties. It will be necessary to conduct considerable experimental work before we know what to expect from some of the native grasses.

As was stated in the previous report (1941) the following grasses were to be included in the study: Andropogon furcatus, big bluestem; Andropogon scoparius, little bluestem; Bouteloua curtipendula, side-oat grama; Bouteloua gracilis, blue grama; Buchloe dactyloides, buffalo grass; Agropyron smithii, western wheatgrass; Elymus canadensis, Canada wild-rye; Oryzopsis hymenoides, Indian ricegrass; Panicum virgatum, switchgrass; Sporobolus asper, tall dropseed; and Sporobolus cryptandrus, sand dropseed.

The procedure for making the purity analysis of the above samples does not offer serious difficulties. There are several minor points which should be determined by additional research.

Because of numerous inquiries which have been received, the work of the committee for the year has centered on germination studies on western wheat grass (Agropyron smithii). Among the questions were the following: When should western wheat grass be planted? Should old or new seed be used, etc.?

Eight samples of Agropyron smithii were secured from various places in the Great Plains Region, namely: Nebraska, Wyoming, Kansas, and Texas. Four hundred seeds from each sample are being germinated at intervals of from four to six weeks. Several of the samples have had as many as six complete tests. Seed produced in both 1940 and 1941 is being used in the tests. The samples are being tested at alternating temperatures of 20 and 30°C. The effect of KNO_3 is also being determined. The research has not been completed. It is to be continued and it is hoped that some definite results will be obtained.

As previously stated information on the germination of native grasses has been limited. Since native grasses do exhibit numerous irregular characteristics, it may not be practical or possible to outline a procedure for germination which will apply in all cases. It is very gratifying to know that several research workers are now supplying much valuable information which will benefit seed analysts.

REPORT OF CHAIRMAN OF SUBCOMMITTEE ON SAND TESTS

C. W. Leggatt

Canadian Department of Agriculture, Ottawa, Canada

The work of this subcommittee this year consisted of testing four samples of sweet clover, which were kindly circulated by G. P. Steinbauer to some 30 laboratories, on each of which blotter tests by the official method and sand tests carried out according to the technique recommended by this subcommittee were requested. The response was very satisfactory, - 23 sets of results being available for study.

The cooperation of all laboratories is greatly appreciated and it is especially satisfactory that so many took part. The results are very voluminous and are therefore not given here in detail. Detailed results were sent to all cooperators.

Two of the samples were quite difficult. As far as tests between blotters are concerned, technique should not have given difficulty, thus the differences are probably largely due to sampling error and interpretation. The average interpretation probably represents a good cross section of the opinion of the association as a whole as to the quality of these samples.

The average results obtained are as follows:

Sample No.	Between Blotters				Sand	
	Normal	Abnormal	Hard	Dead	Normal	Abnormal
	%	%	%	%	%	%
1	59	17	2	22	56	4
2	49	3	45	3	48	2
3	68	16	6	10	64	6
4	49	9	31	11	48	3

It will be noted that in all samples the sand tests are somewhat lower, which seems to be largely attributable to failure of technique in some cases.

The data were analyzed statistically using correlation and analysis of variance with the following conclusions:-

1. The samples changed slightly with time during the period over which the tests were commenced, but the effect is considered negligible compared to the magnitude of the variations observed.

2. In the case of samples 2, 3 and 4, which had appreciable numbers of hard seeds by which the point could be tested the subsamples distributed were reasonably uniform as indicated by the fact that the variability of the hard seeds was practically theoretical.

3. Sample 2, consisting largely of seeds giving normal sprouts or hard seeds, presented no problems, the results being satisfactorily uniform in all cases.

4. In sample 4 the variation between laboratories was not significantly greater than the variation within the results of individual laboratories in the blotter tests (although it was significantly greater than theoretical and therefore excessive) but it was significantly greater in the sand tests.

5. In samples 1 and 3 the variation between laboratories was highly significantly greater than the variation within individual laboratories both in blotters and in sand.

In blotters, the variation within individual laboratories was close to the theoretical in both samples, indicating that conditions and/or interpretation were uniform as far as any given laboratory was concerned. The greater variation between laboratories therefore represents either a different level of interpretation of sprouts or different interpretations of how the official method should be carried out or a combination of both.

In sand, the variation within laboratories was excessive and the variation between laboratories even greater than in blotters.

6. Except in the case of sample 2 which presents no germination problem, the sand test which is intended as a guide in the interpretation sprouts has shown much greater variability than the blotter tests.

The chairman feels that the only way to obtain uniformity is to have practical demonstrations as a basis for discussion. It has been hard for him to understand why a method which is outlined in detail and which succeeds in his own laboratory in giving uniform results should give such variable results when carried out in other laboratories.

The demonstrations, which follow immediately, are in no sense intended to show how the work "ought to be done." They are merely to show how the tests are made when carried out according to the recommendation previously presented by this committee. They are intended to evoke discussion, to bring to light differences of opinion which might reflect themselves in the methods of making the tests and to find out whether assumptions are involved which are not generally acceptable.

Some of these assumptions are as follows:

1. The sand test, as at present under discussion is not intended as a routine form of test.

2. It is therefore permissible to take rather more trouble with it than with an ordinary test.

3. It is intended to serve as a guide for the interpretation of the routine blotter test, being run occasionally as an additional test parallel to a regular blotter test for the purpose of keeping before the mind of the analyst the approximate dividing line between normals and abnormals in the blotter test.

It may also be used in special cases to aid in the interpretation of doubtful samples.

4. Sprouts develop differently in blotters and in sand. Accordingly, the sand test will tell you about how many sprouts should be counted in the blotter test but it will not tell you which.

5. No attempt should be made to make the blotter test correspond exactly to the sand test because the factor of sampling variation must be recognized as acting in both cases. It is only by repeated comparisons that the sampling factor can be ironed out on the average and that the analyst becomes trained to judge where the line should be drawn.

6. In both blotter and sand tests sprouts may be found which it is almost impossible to place. These may be looked upon statistically as sprouts having an even chance of falling in the Normal or Abnormal groups. It is therefore permissible to divide them evenly between the two groups without specifying which goes into which group. It is a mistake to attempt to make decisions too closely or to attempt to make too many classifications of types of sprout.

7. In the sand test certain types of sprout do emerge which nevertheless must be recognized as abnormal. These are: (a) Watery sprouts. (b) Sprouts lacking cotyledons. (c) Sprouts lacking roots. All others should be counted as normal.

8. The sand test is not a sort of miniature greenhouse test but is

to be looked upon purely as a test with an arbitrary mechanically imposed resistance to the emergence of sprouts. Since this resistance cannot be maintained at a uniform level if the tests are allowed to dry out or are watered during the period required, they should be covered with wet blotters kept damp until counted. The tendency to count as watery some of the etiolated sprouts so produced must be guarded against. Truly watery sprouts can usually be detected without difficulty.

9. Counting should be done with as little disturbance of the sand as possible and sprouts should be pulled with the fingers. This latter is so that the analyst can get the feel of the tug given as the sprout comes out and also to avoid injury to sprouts. Abnormal sprouts give no tug.

10. Development of root hairs is a delicately balanced physiological process and too much stress should not be placed upon their presence or absence. Sprouts otherwise normal but lacking root hairs should be counted as normal.

Following the above statement the practical demonstrations were given of computing the amount of water required to add to the air-dry sand and then to show the preparation of a test according to the recommendations. The convention then adjourned to the germination laboratory where it divided into ten groups each of which was given one sand test of each of the four samples of sweet clover mentioned in the beginning of the report. These sand tests had been prepared prior to the start of the meeting using exactly the same method as that demonstrated. Each group appointed a counter and the counts were interpreted according to the general views of the group supplemented by discussion with referees who circulated among the tables.

Chairman's comments: It appeared evident that the main factor in variations between laboratories was not so much difference in interpretation, although this did exist to some slight extent, but in technique. The general feeling, before the tests were counted, seemed to be one of scepticism as to there being sufficient moisture according to the method recommended. The tests clearly demonstrated that there was sufficient and that when the tests are carried out as recommended, statistically uniform results are obtained. The following tabulation gives the results of the statistical analysis:

Sample	X^2	n	P
No. 1	4.84	9	>.8
No. 2	16.39	9	>.05
No. 3	8.79	9	>.4
No. 4	6.87	9	>.6

In no case were the differences between tests counted by ten separate groups significant. This result, which is quite striking, clearly demonstrates that, provided the technique is made uniform, there is no sufficient reason for excessive differences between laboratories.

It is believed that this technique is now perfected for use with clovers, flax, onion and carrot and possibly some other seed kinds and the recommendation is made that it be passed on for consideration by the Committee on Standardized Tests.

REPORT OF SUBCOMMITTEE ON THE STUDY OF VIABILITY OF INJURED WEED SEEDS

Dorcas Hooker, Chairman

State Department of Agriculture, Richmond, Va.

The following is the report of the Subcommittee on the Study of the Viability of Injured Weed Seeds for the past year. Very few members were able to undertake any study because of the heavy amount of work in the various laboratories. Those who did participate made reports as follows:

DODDER OBSERVATIONS

By Grace E. Miller

Univ. of Missouri, Columbia, Missouri

Field Observations:

1. Dodder plants ½ to 1 inch in length from their first point of attachment were found on lespedeza plants on May 1, 1942 in a field at the experiment station at Columbia, Missouri. This indicated a recent germination, and the patch could have been easily destroyed at this time. Six weeks later, a large vigorously growing mass of dodder was found just coming into bloom.

2. Dodder Capsule Content Study.

A heavily fruiting mass of dodder was collected from a lespedeza plot on the University of Missouri farm in the late summer of 1940. It was dried and stored in a screw cap jar. The seeds in each of 2 x 100 capsules were tabulated and separated according to color. Seeds in the same capsule were found to vary much in color; or to be all of the same color. The capsules average 56% of their total seed capacity. The ashy colored seeds average 18%; those all light gray 12%; lemon tinged 16%; rust color 44%; and brown 10%. Only 2% of the capsules developed their capacity of four uninjured seeds of normal size and color. Of the second hundred capsules 84% showed a hole in the side or a discoloration suggesting the sting of an insect. Eight dead larvae and a pupa of Coleoptera were found within the capsule; several larvae were found within seeds. Many seeds had been eaten or injured by insects. Most of the remaining unopened mass of capsules also showed insect injury externally which suggested that this might be one reason why dodder in Missouri has not been as serious a pest as it might be; also that insect injury might be one reason for failure of the embryo and seed coats to develop normally resulting in the varied peculiarities of the seed in color of coat and degree of chalkiness. The 2% of capsules showing 4 mature seeds of normal coat appearance did not show any visible insect injury to the capsule externally.

Germination Observations:

Missouri service test 2344, had seeds of dodder in which the heavy outer seed coat or testa was practically gone; - in some seeds a bit of testa still adhered. In all cases the thin yellowish inner integument with the coiled embryo showing thru, was still present. The seedlings were counted as vigorous if they showed an enlarged white radicle with hairlike processes at the tip and a yellow hypocotyl more or less uncoiled. They were germinated at 20-30° between blotters wet with distilled water. The 2 x 100 seeds averaged 31% germination in 39 hours; 65% germination in 160

hours with one additional seed which was abnormal and did not develop after partial germination. The remaining seeds were decayed. Test continued from May 28 to June 4, 1942.

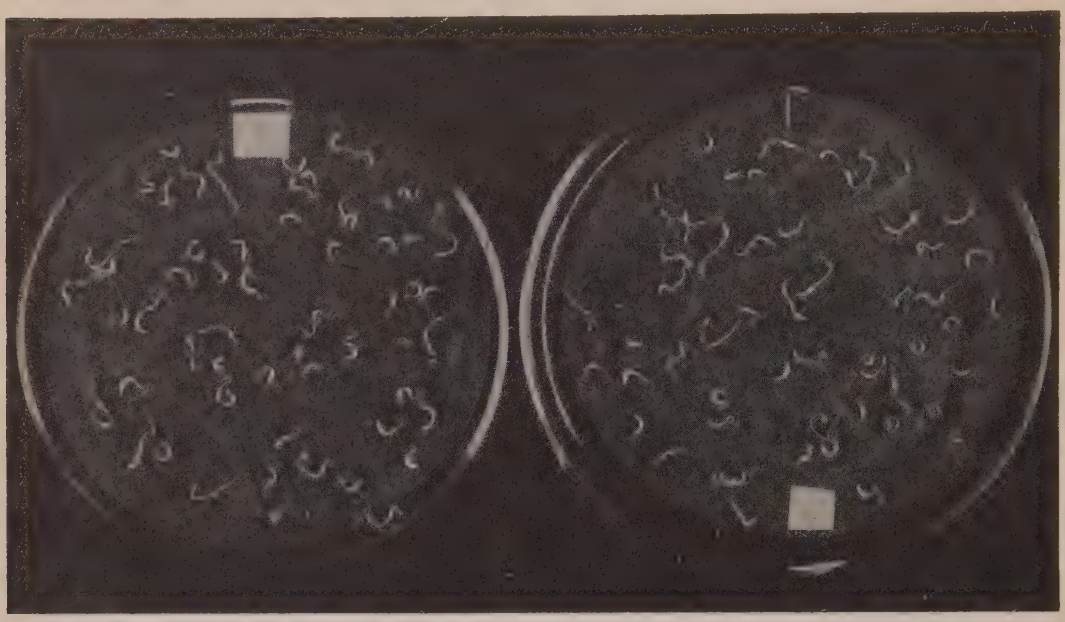


Fig. 1. Photographs showing germination of decorticated dodder seed from Missouri sample of lespedeza No. 2344. Final germination count gave 65% germination. Seeds germinated between blotters but placed in petri dishes for photographing.

(Photo by Field Crops Department, University of Missouri, Cooperative Seed Testing Laboratory June 11, 1942)

GERMINATION OF GREEN FOXTAIL SEEDS

A. C. Heise

Canadian Department of Agriculture, Winnipeg, Canada

Owing to heavy pressure of routine tests, it was only possible to prepare and germinate one sample this season. "Seeds" of Green Foxtail (Setaria viridis) were classified into four groups as follows: Class No. 1, glumes and caryopses intact and undamaged; Class No. 2, dehulled (glumes removed) but caryopses undamaged; Class No. 3, dehulled, top of embryo skinned but caryopses otherwise undamaged; Class No. 4, dehulled, tip of embryo broken off. A fifth class might have been included but was omitted because results in the past have shown that caryopses having embryos damaged to any extent fail to germinate. The seeds were separated under the binocular to determine accurately into which class each seed should be placed.

The "seeds" were planted in sand in petri dishes in light at 20 - 30°C, and the tests were read at appropriate intervals until it was certain that no more seedlings would emerge. It was found that germination was complete at 7 days although the tests were continued for 16 days.

The tests of Classes 2, 3, and 4 showed mould at the first count on the third day, but Class 1 was free from mould at the first count and showed mould at the second count on the seventh day.

Following are the readings at 7 days in percentage of normal seedlings:

TABLE 1. - Germination of Green Foxtail Seeds

	Class 1	Class 2	Class 3	Class 4
	89 86	13 18	1 2	0 0
Average	87.5	15.5	1.5	0

WILD ONION BULBLETS

Dorcas Hooker

State Department of Agriculture, Rochard, Va.

Further study on the germination of wild onion bulblets has been conducted in the Virginia laboratory to prove, if possible, the hypothesis presented at the meeting in 1941, namely, That wild onion bulblets that do not have the "basal end" present or that have the "basal end" severely damaged should not be counted as weed seeds.

In all the experiments the material was placed in the germinators at a temperature of 10-20°C. Previously 20-30°C was used and fairly good results obtained. We now believe 10-20° to be the more favorable temperature. The substrata used was moist Scott tissue and waxed paper; the latter was placed over the bulblets before the whole was rolled into a rag doll.

We have determined that for experimental purposes it is best to use bulblets that are well dried. The bulblets used were taken from heads collected from the field the previous year and stored since then in tin boxes. All bulblets were of approximately the same size and maturity.

The experiments were made on whole bulblets and bulblets cut in half with a razor blade.

One group of bulblets was cut in half crosswise as near the middle of the bulblet as possible. As a result, 85% of the bottoms sprouted, "strong," as shown in Fig. 1.

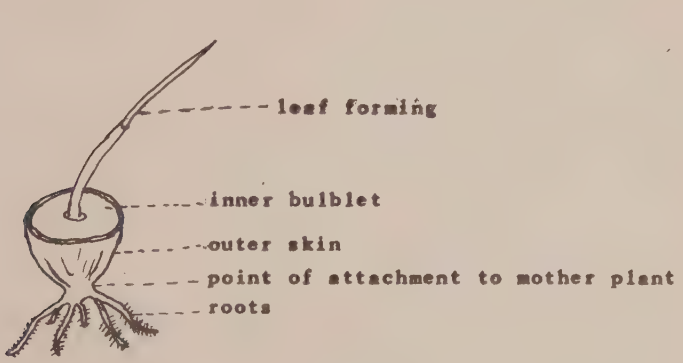


Fig. 1. Diagram of base of wild onion bulblet showing sprout after ten days.

The tops developed as shown in Fig. 2. At the end of 18 days these showed no root development and by this time the majority of the parts that were apparently the leaf had shriveled and fallen out of the bulblet tops. 75% behaved in this manner. The remainder remained dormant.

Another group was cut in half longitudinally. Both sides of the bulblets used were placed on the same substrata. Forty-five% sprouted "strong" and 21% "weak". In this case, on one set of bulblets used, a second growth occurred as follows: A small bulblet grew at the basal end on the interior of the mother bulblet. This was at the same time as the development of the root and leaf parts. The growth resulting on many of the halves was distorted, but at the same time had both root and leaf parts present. Some of them showed a complete development, as in Fig. 3.

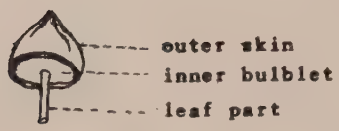


Fig. 2. Diagram of top of bulblet showing growth after ten days.

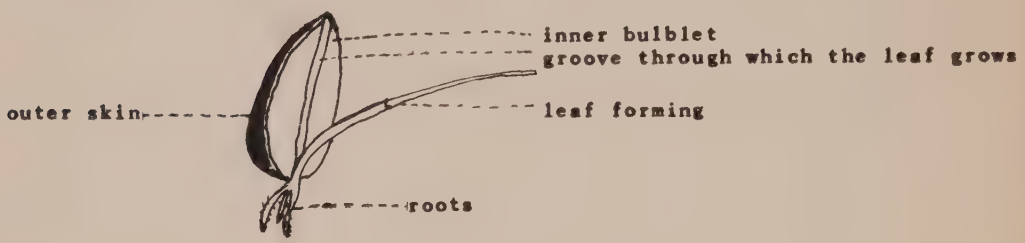


Fig. 3. Diagram of longitudinal-half of bulblet showing growth after ten days.

Conclusions: The basal halves of wild onion bulblets and those damaged lengthwise but with the basal ends present at least in part are capable of developing normal sprouts and roots. For this reason, in seed testing, basal portions of bulblets when present to the extent of half size and longitudinal halves of bulblets with some of the basal end present should be included in the weed seed percentage and in the count per given weight.

Tops of bulblets should not be classified as weeds but should be included in with the inert matter.

THE PROGRAM

THE REPORT OF THE PROGRAM COMMITTEE

As a forerunner to the formation of a program for 1942 the chairman directed a questionnaire to all member laboratories and also to members of the Commercial Seed Analysts Association. The questionnaire was designed to get a summary of the things with which analysts were most concerned as well as to know what new matters could be mentioned. The committee also felt that it was very desirable to know how large a meeting to expect and to provide accommodations accordingly. The reaction was in general for some continuation of the school principal. The approach concerning the study of abnormal germination seemed to best present the matter through a study of slides; for the reason that it is not always possible to have material at just the right stage for observation. This to be followed by actual material.

Many reports were received asking for a repetition of the studies concerning the identification of some of the Agropyron, Brassica, and Agrostis species by Miss Albina Musil.

Inasmuch as analytical work is only one of the problems involved in seed laws, with the further thought that many analysts are also the administrative agents of the law, many requests indicated a growing desire to have an administrative law session.

Inasmuch as many of our seed problems are also the problems of the Trade we will have with us Mr. H. Trimble McCullough representing the American Seed Trade Association.

For recreation, a Southern Barbeque will be provided. Places of historical interest will be visited including stock and seed farms and a seed processing plant.

Professor and Mrs. W. A. Price will hold an informal reception at their home. Music and sketches by Mr. John Jacob Niles, noted Composer and Folk song authority will be greatly enjoyed.

The committee expresses their appreciation for the splendid co-operation received. To the committee, it is the program of your choosing.- C. N. McIntyre, Chairman

PRESIDENTIAL ADDRESS

F. A. McLaughlin

Massachusetts Agricultural College, Amherst, Mass.

A Presentation of Several Association Problems for Further Thought and Consideration

We are in this meeting assembled for the thirty-fourth time to discuss and consider the ways and means by which we can more efficiently and adequately conduct the responsibilities which are implied by the constitution of the Association of Official Seed Analysts and accepted by us in furthering the value of our work to mankind through service to agriculture.

Probably at no time during the years have the demands been so great upon the resources of our seed laboratories and the various agencies which are responsible for seed testing, administration of seed laws, and seed education in general. In a former issue of the News Letter I made the

statement that no particular emergency of a new kind existed but that to me it seemed that the demands upon us, although particularly heavy, were only the perennial demands increasing each succeeding year because of a growing appreciation for the value and benefit of past services. I still hold to this view and I feel sure that even with the increased demands for testing, our laboratories have by one means or other been able to satisfactorily and creditably render complete and adequate service.

It has been said in a former presidential address that this organization is essentially a scientific body but the scope of the work is much larger than this field alone. That this statement is true and recognized by us is evidenced by the program before us today in which there appears a presentation of administrative law. I might give further evidence of the varied nature of the problems which confront us other than those of a scientific and administrative nature. My purpose in referring to the wide field of our interests, however, is taken as justification in presenting to you various opinions and ideas which have become of common interest to me through my connections with this organization and the responsibilities confronting me each day as a part of analytical and administrative laboratory work.

You will pardon therefore my discussion which deals with subjects often presented before this organization, yet still in the category of that famous remark of Charles Dudley Warner: "Everybody talks about the weather, but nobody does anything about it." Perhaps the implication of my quotation is overdrawn, because I realize that in certain instances much has been done, yet I wish to emphasize the fact that there still remains much more for us to do. Also, I must beg your indulgence for discussions which may savor of the small laboratory perspective and be due more or less to an influence of conditions more prevalent in New England than elsewhere.

Research

It is not my purpose to dwell upon the subject of research, but considering the load of routine demands on laboratory staffs, the amount which has been done and is in process is indeed remarkable and praiseworthy. Along this line, however, an effort should be made to add men and women for research work only to the personnel of laboratories. Some of the larger and more strongly financed laboratories have already taken on qualified men for research work only, and to those laboratories for the present we shall have to look for the most progressive type of research. There is, however, one source of research which to me seems in many cases neglected. I refer to laboratories located at State Universities and Colleges where there may be strong science departments. Often such departments lack the necessary apparatus for seed research, yet purely physiological, pathological, and like projects could be worked at least on a cooperative basis.

As an Association project the field of pathology offers unlimited opportunities and although we have a phytopathological committee which each year turns out a limited amount of work, we have not as yet begun to accomplish the valuable results which can be expected from this field of endeavor. Some small amount of work has resulted in certain recommended seed treatments. Of course pathologists in strictly scientific departments have long since worked out formulae and demonstrated the effectiveness of certain substances for this purpose. I believe we should be applying their recommendations in more of our laboratory procedures. Many or all laboratories in certain instances would do well to report germination both for

seed as received and for seed treated. I am aware that some few have already practiced this procedure to a limited degree and that the additional work involved may be a real problem, but I do feel that the benefits justify consideration.

What is an Official Laboratory?

The meetings which we are holding here are underwritten by the Association of Official Seed Analysts, a society of which the constitution states that "member laboratories shall consist of groups of individuals working as seed analysts or workers on seed research problems in recognized government seed laboratories." By the payment of certain laboratory dues and by conforming to certain recommendations, such as employing persons with certain qualifications as to education and training and by conducting our work by means of certain recommended equipment, as individuals we receive the title of official analysts and work in official laboratories. As a matter of fact, it is by our own statement that such qualifications are fulfilled and by the payment of certain dues assessed that we retain the personal assurance that we are official analysts. Is this sufficient?

Whereas I believe that every member laboratory strives to fulfill all conditions which make their membership official, I do know that in certain states where seed work has not as yet become fully appreciated, laboratory heads are unable to hold to the highest standards in equipment and personnel. For instance, some of our laboratories are housed under such adverse conditions that every condition necessary to official testing cannot be fulfilled. Light is poor, atmospheric temperatures are too high, apparatus is inadequate, and many more obstacles which might be enumerated are often encountered. Take, for instance, the present recognized importance of more soil tests for certain crop seeds. What can a laboratory do without greenhouse facilities, and with but one or two Minnesota germinators when there are several hundred samples of beans which should be tested in soil or sand?

Such laboratories need a moral support greater than is implied by membership in the A.O.S.A. To my way of thinking, in order to continually qualify as official laboratories, we should not only have to comply with a given set of conditions, but be subject to a periodical inspection by an official of the Association as proof that official procedures are fulfilled. A report should then be issued to the Association and to the laboratory, naming deficiencies if any exist, and recommending such corrective measures as our Association regulations imply. Laboratories which are unable or are unwilling to comply after a given time should be placed on probation or declared as no longer official. An inspection of this nature would in some instances greatly assist a laboratory head in gaining recognition and correction for laboratory ills which he has often presented to departmental and institution heads. Such an inspection, I understand, is conducted regularly in Canada by annual visitation of the Chief to each Provincial laboratory. In the States the Association might name an official inspector for each district and any expense borne in travel by such an official be reimbursed by the Association.

Schools

It has been particularly gratifying during the past year to be invited to a school of instruction at the Beltsville Laboratories and to

profit by the excellent demonstrations prepared for analysts of the Northeast district. There have been notices in Seed Trade Journals that similar schools of instruction were operating in different parts of the country under the guidance of state analysts and members of the Beltsville staff. Such schools should contribute widely to more uniformity in interpretation of our various methods. If this year's practice is part of a policy which is to be continued from time to time, it may fulfill the need many of us have felt that a school of instruction should be open to members of our various official and commercial laboratories and that an official laboratory to retain its rating should participate at definitely stated intervals. In the school and college system teachers and investigators are often required to attend schools of instruction for a short period every third year in order to hold their appointments. With the frequent changes in our methods and new research available, is it unreasonable to expect that our laboratories be kept in line with new thought and practice by some type of organized instruction? It seems to me that perhaps these sectional schools of instruction may now supply the need of former years for course work in key laboratories.

Extension

In the administration of our various state seed laws we find in one instance a laboratory under the jurisdiction of the Experiment Station with enforcement delegated to a State Department. In others, both laboratory and enforcement are under either one heading or the other. Ordinarily, there is less political interference with the work and personnel when all or part of the work is under the jurisdiction of an experiment station, but no matter what the set-up may be, the responsibility for effective seed control is broader than administration of the law which in the case of too many states seems to be the only objective.

Those of you who fortunately work in a state laboratory where agriculture is the chief industry of the state and where your representatives are from the farm, find that your needs are reasonably well financed and your work is understood and morally supported. In some of these states we find extension services cooperating with all seed interests and aiding in carrying the results of your work effectively to the farmer. In others, however, we find hundreds of thousands of dollars to finance extension activities in conduct of the farm and the home, but only a paltry few thousands for the seed laboratory which deals entirely with the value of seed, the most important item to be observed as the foundation of successful farm practice.

By this time you may have heard a report from the Public Service Committee on extension activities of the United States in relation to the work you and I are turning out in various seed laboratories. From this I am sure you will have learned that certain states have absolutely no extension projects dealing with better seeds.

Illustrated Talks

Too often laboratory staffs carry sufficient burden in performing the strictly laboratory problems. However, opportunities arise when an illustrated lecture on the laboratory work and its application to the farm would create a better understanding between laboratory and those who employ and profit by its service.

Illustrated talks before seedsmen, farmer groups, and other organizations, imply the possession of motion film or stills. Laboratories in some instances attached to control services have no appropriations for such supplies and apparatus and are instructed that their work is not particularly educational but strictly in line with analysis and germination of inspection or farmer samples. There are states where the seed laboratory is absolutely the only interest in better seeds, yet by virtue of their particular departmental attachment no activity beyond the restrictions named above is encouraged.

There are excellent films and slides which have been prepared by seed departments and laboratories in the several states where the broad value of seed education is recognized. I believe it is feasible for our Association to catalog such illustrative material as may be possessed by the various laboratories and departments with the object of obtaining a loan of this equipment for a limited time by laboratories not so favorably situated.

It seems to me that one valuable work which might be undertaken is the preparation of two sets of film covering in the one instance a popular but complete presentation of laboratory procedure, and in the other instance a set of film more for the staff of any individual laboratory and which has been designed to illustrate normal and abnormal seedlings of any one or all the important agricultural seed.

We have seen, or shall see, at this conference the projection of photographs in color to illustrate normal and abnormal seedlings. Perhaps one of the most constructive efforts toward uniformity we can consummate will be to agree here and now just what degree of normality and abnormality we are willing to accept. But the presentation here is not sufficient. It will be necessary for us to see these projections again, and perhaps several times, in order to fix in our own minds sufficient impression for future judgment and action.

We are all grateful for the photographs which have been prepared by the U.S.D.A. Laboratories. These have been of great assistance in formulating our ideas toward greater uniformity. An appreciation of the principles which they illustrate is responsible for the several ideas just enumerated.

The News Letter

Few perhaps of those who subscribe to the News Letter realize the amount of work and thought which goes into every issue. Editors of this publication have turned out a very presentable product entirely on their own time and sometimes partly at their own expense. They have done a remarkable job with the material at hand, but too often an issue is held for sufficient subject matter to make its composition worth while for mailing. I feel that in this publication the Association as a whole must invest a greater effort.

A few years ago one of our members advanced the idea that each laboratory should every month prepare some news item on current news or research, but this suggestion has not been followed.

Mr. McIntyre has this year been faced with a very meager number of contributions, yet by his own effort, ability and ingenuity, has given us a readable and helpful set of News Letters.

It appears to me that more Association effort is needed to make this house organ of increasing importance. Perhaps a larger editorial board

may be one effective avenue of approach. Success of this publication is partly dependent upon financial support. I believe an editor should be given a certain amount of money for his personal services and in some instances for the employment of persons with particular ability to make illustrations, review current publications, or in other ways to bring before us useful topics on research of the day. It might also be possible with such assistance to come out with a definite number of issues per year, each on a given date, rather than to wait for sufficient contributions before setting up and mailing any particular issue.

Testing of Flower Seeds

The lack of official methods for testing of flower seeds has several times been expressed at our annual meetings, yet in every instance the thought has been voiced that there are too many pressing problems relating to the work we are now doing, or that varieties and strains of flowers present too varied considerations to be given any thought at this time. Perhaps your laboratory is in a position to ignore service to seedsmen who have no laboratories, but some of the laboratories have to meet reasonable demands for this type of work. There are a few rules available for testing certain varieties, yet the whole field is wide open and I feel that the time is near or at hand when a reasonable amount of research should be undertaken and common agreement reached on methods, starting with common varieties, to be employed in testing of flower seeds.

Field Testing

Many of the state seed laws permit or require the testing of agricultural seed for conformity to type. Methods and procedure have been adequately described in former articles appearing in Proceedings and elsewhere. There has, however, been a lack of coordination of the work in various states and stations which I believe could, if properly organized by agreement among the various agencies, accomplish valuable comparative results. We recognize the fact that an Earliana tomato, for instance, cannot be described as a uniform type for every state where this variety may be grown. It seems, however, that if the various projects in several states were planned each year to grow by agreement the same strains and varieties of given crops, that comparison of results might later be of great value to both seedsmen and farmers, and at the same time accomplish the object of proving that the variety found is that named on the label as required by law.

From the foregoing discussion it appears that to carry out some of the principles expressed, such as a paid editor of the News Letter, travel account for an Association officer on official inspection of laboratories, preparation of film for illustrated lectures and laboratory demonstration, and a point not expressed but of occasional occurrence--invitation extended to officers of A.O.S.A. to represent this Association at scientific meetings, that our present finances would not admit of such an extended program.

To meet further Association activities, which if approved involved larger financial resources, it occurs to me that a part or all of such needed funds might be forthcoming by an assessment of individual Association dues. Very few scientific societies to which I subscribe have dues of less than five dollars for each individual member, yet we are content to depend solely on assessments against our individual laboratories paid out

of the state or government funds. I maintain that the benefits which our laboratories derive by such membership in turn are reflected upon our own individual gains and for which we should be willing to contribute of our own individual means.

May I at this time thank you for the honor which you have bestowed upon me in electing me to serve the Association of Official Seed Analysts as president during the past year.

A Message from the American Seed Trade Association

A. Trimble McCullough

McCullough Seed Co., Cincinnati, Ohio

It was indeed gracious of your President to invite the President of the American Seed Trade Association to speak to you. Our President regrets that he cannot be here, and has asked me to take his place. I am very happy to be here, and consider it a privilege to bring you greetings and best wishes from the American Seed Trade Association.

As I look back on the last few years of contact between the members of your Association and those in the Seed Trade, it is most highly pleasing to be able to note the great progress made in cooperation and understanding between our groups.

The last few years has seen many new seed laws, likewise the Federal Seed Act has come into existence. There have been problems presented with all of these new laws. It is certainly most gratifying to the seed industry to be able to look back on the intelligent handling of the many problems that have come up in connection with these laws. Mr. Davidson has been very helpful in solving the many difficulties that have been presented to him from time to time, and I am sure that all of the seedsmen are grateful to him.

The seedsmen have also been more inclined to look at both sides of the question, and because of a better understanding between our two groups, I think we have all benefitted and I am sure that you will find the seedsmen ready and willing to continue with this open policy.

I do believe that the policing method of enforcement upon which our seed laws are based can and will reach a greater degree of effectiveness when the farmer has become educated to the necessity of buying weed free seeds and how they can be acquired. Your President in his address has stressed the need for educational programs. Now, the seedsmen will agree that this is a very valuable step in the right direction. You people are able to put on the proper campaigns in your own states that will show the farmers how to evaluate the information he receives from the analysis tag contained on the seed bag.

I have brought with me some colored slides which represent subjects which are I believe of interest to all of us. Some of the slides represent the weeds which trouble the farmer and the same weeds that trouble the seed cleaner and are later the subject of controversies between analysts and seedsmen. If we can find ways and means of bringing the right kind of information to the farmers, perhaps the production of some of these troublesome weeds can be stopped at their source, on the farm. Dr. Price, right here in Lexington has started a mighty fine educational program, with Mr. Ensil Dean in charge. Mr. Dean is carrying a message of better seeds and better farming methods into the different districts of the State of Kentucky.

In Indiana the officials with Mr. Carter, and Mr. Oliver C. Lee in charge of the educational work on weeds, the Indiana Seed Law and related problems have been doing a fine job. Mc. McIntyre, in charge of the Ohio Seed work has already started a program for educational work in our state. The Ohio Seed Dealers' Association is just introducing an educational program. I am sure that you will find that the seedsmen in all of the states are willing to cooperate with such programs when sponsored by officials of their states. (At this point Mr. McCullough presented a series of colored slides depicting: (1) Weed seeds which are commonly found to be troublesome to agriculture. (2) Farming methods which produce these weed seeds in volume compared with results obtained when good farming methods are used, eliminating the larger volume of weeds, resulting in good clean fields. (3) Machinery and methods used in a modern seed cleaning plant to clean and process seed with the ever present aim in mind, - cleaner and better seeds.)

The seedsman's aim is to remove these troublesome weeds from the seed crops that he takes into his warehouse. The seedsmen are pleased to note the attitude and relationship between analysts and seedsmen in the last few years, compared with the situation of former years. The seedsmen do not produce the seed crops. The seedsmen are charged only with the processing and recleaning of the seed crops to produce weed free seeds. The weed seed situation can and will be helped when the farmer is educated to the fact that seed containing weeds is always poor economy. I am sure you will find the seedsmen ready to cooperate with you at all times with any educational program for farmers launched upon by analysts and state officials.

FEDERAL SEED LAW ADMINISTRATION

W. A. Davidson
Senior Marketing Specialist

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING ADMINISTRATION
Washington, D.C.

My discussion of seed law administration is from a Federal point of view. It is my understanding that a similar discussion will be presented from a State point of view.

The War

The war has created a tremendous demand for larger than normal quantities of foods of many kinds and seeds of many kinds to grow such foods. The normal procedure in seed production and distribution has been disturbed. Short supplies of some kinds and advanced prices have been the result. There never has been a time when it was more important than at present for seed laws to be administered is such a manner as to accomplish their purpose. Since 1938 there has been a concentrated interest in Federal and State seed legislation. It seems proper to review what has been accomplished. It seems imperative that this be done now when the planting by the farmer and the gardener of the seeds of the best variety for their purposes and of good quality is of such great importance.

Federal-State Cooperation

You are all familiar with the fact that the Federal Seed Act is administered in a manner to utilize insofar as it is possible the cooperative efforts of State agencies. To make this possible, memoranda of understanding are in effect with 45 States. To approximately 250 State inspectors have been issued identification cards which show that authority has been given to them to inspect seeds within their respective States in the administration of the Federal Seed Act. The results of the inspection by these State officials in the administration of the interstate provisions of the Federal Seed Act are far reaching. Approximately 50 per cent of the cases that involved apparent violation of the act and were considered by the Washington office during the past year were first inspected by State employees in their routine activities. These cases were reported to Federal employees located in the regional seed laboratories. They were further investigated, and upon the completion of the investigation were reported to the Washington office. Definite action of one form or another seemed warranted in practically all cases that were brought to our attention as a result of State inspection.

These cooperative efforts require recognition of a delicate line that separates the jurisdiction and responsibilities of Federal and State seed law enforcement agencies. That which is interstate commerce should be the responsibility of the Federal agency and that which is intrastate commerce should be the responsibility of the State agency. At times it is difficult to determine which is interstate and which is intrastate.

The Federal Seed Act requires that seed shipped in interstate commerce shall be completely and correctly labeled. This applies to the seed at the time it is shipped in interstate commerce. It is not required by the Federal Seed Act that the shipper shall undertake the obligation to see that the seed continues to be correctly labeled indefinitely. If the seed is correctly labeled when shipped in interstate commerce the responsibility of that shipper under the Federal Seed Act has been fulfilled. If it was not fulfilled, it is a matter for the consideration of Federal officials. If it was fulfilled but the seed changed in its condition so that at some later date the statements with respect to the quality are no longer true the obligation to correct the labeling is that of the person residing within the State who is in possession of the seed.

We do not believe it is properly within the jurisdiction of the State to enter into negotiations with the interstate shipper in any instance in which the seed after delivery into the State is found for some reason not to be in compliance with the State law. The negotiations in such circumstances should be undertaken with the person residing within the State. It would, of course, be desirable if the requirements of the Federal Seed Act were such that correctly labeled seed would meet the requirementsof the law of the State into which it was shipped. The Federal Seed Act was so worded as to do this insofar as it seemed feasible. To further accomplish this the Department in cooperation with the official seed analysts and other agencies took steps to encourage the adoption by the State of laws consistent with the Federal Seed Act. The response to this on the part of the States has been very encouraging.

Noxious Weeds

The interest of the Federal Government in the State seed laws also arises from the fact that seeds shipped in interstate commerce must comply

with the noxious-weed seed requirements of the State into which the seed is shipped. Uniformity in these requirements would, of course, be very helpful to the seed trade as well as to the Federal Government. A number of southeastern States took a long step in the right direction a year ago when they held a conference to develop uniform noxious-weed seed provisions in their seed laws. We have published the State noxious-weed seed requirements in order that they may be universally known. In a few instances these requirements are not as clear as they should be. There is a legal concept that requirements of law should be clearcut and not readily subject to misinterpretation.

Seed Testing

The Association of Official Seed Analysts has for years combatted in ways at its disposal the lack of uniformity in the results of tests made in different seed laboratories. The situation is often exaggerated, but lack of uniformity to any extent is embarrassing to seed analysts and even more so to persons relying upon seed analysts in the administration of seed laws. In a further effort to encourage greater uniformity in testing the Department has made available for distribution prints of photographs of seedlings taken during germination tests. These prints show seedlings that are interpreted to be normal and those that are interpreted to be abnormal. It is conceded that we may not all be in agreement on the interpretations that were made. It is hoped, however, that they will serve as a basis for reaching closer agreement.

Seed schools in cooperation with State agencies were held in the Federal-State Seed Laboratories for official analysts in 1941 and for commercial analysts in 1942. In these schools or conferences it was possible for each person attending to make detailed tests and to compare the procedure followed and the results obtained with other analysts.

It has been necessary for the Department to discontinue service testing because the facilities required to do the work were needed in the administration of the Federal Seed Act. We have continued, however, to make service tests for seed analysts in those instances where it appeared the test might contribute toward greater uniformity in interpretation. In such instances we have attempted to get a portion of the original sample, the test of which was being questioned. We have in a few instances found that analysts had destroyed the sample, which action seemed somewhat premature. Storage conditions for the retaining of samples are not available to all analysts; however, it is urged that they retain samples if at all possible for at least a period of a year.

The enactment of the Federal Seed Act and the increased interest in State seed laws have resulted in a tremendous increase in the demand for seed testing. It has seemed that reliable seed tests have not been available at all times to those who were sorely in need of such tests. State laboratories have been overcrowded and some commercial laboratories have not been equipped to make dependable tests. This situation has been given careful thought even to the extent of considering whether it would be improved if a system were established for licensing all persons who may test seeds for the purpose of determining how such seeds should be labeled when shipped in interstate commerce. It may be preferable as an alternative for the Department again to undertake the making of service tests on a fee basis on a scale that would relieve the present situation.

There seems to have been some misunderstanding with respect to the

part played by the tolerances which are required to be recognized in the administration of the Federal Seed Act. It should be remembered that tolerances are not for the purpose of permitting labeling to show higher quality than is actually found by tests. They are designed to cover the unavoidable variation in the results of tests. If the tolerance is used prior to the labeling of the seed, the seedsman in effect deprives himself of this protection.

There have been numerous instances in recent years in which the germination of timothy seed seemed to be much lower than would naturally be expected. The conditions that have contributed toward this may involve the use of combines in harvesting. In any event much of the timothy seed should never have entered seed trade channels.

Many of you know about the experience of farmers who have submitted samples of uncleaned seed to a seed laboratory in order to learn the seed's quality, only to be told that the laboratory makes no tests on uncleaned seed. This situation is not true in all State seed laboratories. It would seem that the farmers should be informed of the quality of the seed in such circumstances. It should not be necessary to make a test of the kind which is usually made for such a test would require too much time. Serious consideration may well be given to whether there should be instituted at the various official seed laboratories, a service to farmers and country shippers of uncleaned seed, that would prevent lots containing noxious-weed seeds and those of low germination from entering seed trade channels. Such a service would no doubt have a tendency to encourage the production of seed of higher quality.

Activities under the Federal Seed Act

During the past year 483 cases of apparent violations of the Federal Seed Act were considered by the Washington office. This is an increase of 38 percent over the previous year. A review of the details involved in these alleged violations in which some action has been taken since July 1, 1941 reveals a distribution of the violations somewhat as follows:

False labeling as to percentage of purity in	29% of the cases
False labeling as to germination	" 29% " " "
False labeling as to variety	" 15% " " "
Incomplete labeling	" 17% " " "
Failure to label	" 10% " " "
Violation of State noxious-weed requirements	17% " " "
False advertising	" 8% " " "

After giving final consideration to these cases, definite action was taken in the following manner:

22 seizures were recommended; 36 persons were advised that prosecution was contemplated and were offered an opportunity to express their views in the case; prosecutions were recommended in 26 instances; warnings were issued in 235 cases; and no action seemed warranted in 298 cases. The circumstances in the 20 cases that were terminated in court during the last year will be published soon.

In the investigation of some of these cases it has seemed obvious that the lot of seed had not been bulked to uniform quality. This results in the obtaining of samples that are not truly representative of the lot. It also offers a challenge to inspectors of seeds as they attempt to obtain a representative sample.

It is also obvious that false labeling as to noxious-weed seeds frequently occurred because the label was based on the usual pure seed determination and not a noxious-weed seed examination. Persons who label seed should be urged to take the precaution of obtaining the results of a noxious-weed seed examination, and seed analysts should be urged to be sure the report of a pure seed test is so worded as to make it clear that a noxious-weed seed examination was not made if this is a fact.

During the past year approximately 1,000 samples of seed were tested by the Department to determine their variety. These were tests in addition to ordinary pure seed determinations. They involved fluorescence tests for ryegrass, cold resistance tests on alfalfa, and greenhouse and field plantings. It seems essential as a part of the war effort to increase the testing for variety in order that there may be a higher degree of accuracy in the labeling of seed. We have found it necessary to seek the cooperation of agronomists in making these tests since we cannot hope to be familiar with the characteristics of the growing plants of all varieties of the many kinds of seeds. We anticipate that in time all agricultural seeds will be required to be labeled as to variety or with a statement that the variety is not known. We also anticipate that the use of new variety names will be permitted only after the Government has had an opportunity to determine whether a new variety name is warranted.

In the administration of the act we have encountered shipments in interstate commerce of grain that was desired for planting purposes but which was ostensibly shipped for other than seeding purposes. In determining whether such shipments were in fact for seeding purposes and therefore subject to the labeling requirements under the seed act, it has been interpreted that the nature of the order or the inquiry on the part of the buyer shall be the deciding factor. This is the interpretation even though the shipper of the seed represents it to be for other than seeding purposes. A similar interpretation is made in determining whether a shipment is "for processing."

There has been much criticism of the provisions of the Federal Seed Act that require a label to be attached to each bag of seed even though the bags are shipped in carload lots and are to be relabeled after the shipment in interstate commerce has been completed. It seems that an amendment to the act must be made in order to relieve the shipper of this requirement. We feel that there would be no difficulty, however, in administering a provision that would exempt the shipper from the labeling of each and every bag in those circumstances in which the seed is to be relabeled and permission of the consignee is obtained.

It will be necessary to consider amendments to the regulations under the Federal Seed Act at an early date. It would seem desirable at that time to consider adding within the definition of agricultural seeds the names of those kinds that have in recent years entered seed trade channels but that have not been added to the definition of agricultural seeds because methods of testing were not well developed. The Department would welcome the recommendation of this Association as to the kinds of seeds that should be added and the methods by which such seeds may be tested to determine their purity and germination. We would likewise welcome any other suggestions. An example is the suggestion received that the germination standard for watercress be raised above the present standard of 25 per cent.

In a memorandum to State seed officials in January 1942 I indicated the need for extraordinary efforts in seed control. It was stated that the present cooperative arrangements between the United States Department of

Agriculture and State seed officials placed the State inspector figuratively speaking on the "firing line." We cannot be quibbling over technicalities. Instead, our energies should be devoted to forceful administration of items that are of practical significance. We should not lead the seed buyer by his hand in order that he may be properly protected, for he must learn to make use himself of the facilities that are for his protection. We should urge the buyer to "beware" and the seller to "be fair."

STATE SEED LAW ADMINISTRATION

C. N. McIntyre

State Department of Agriculture, Columbus, Ohio

As one associated with law enforcement duties it is needless to say I have been face to face with many problems arising out of the Ohio Agricultural Seed Law. Undoubtedly other persons so situated have had problems of their own as indicated by replies to a letter addressed to all states sometime ago.

Any law to be worthy of a place on the statute books should be enforced. Seed laws are no exception. Aggressive action on the part of the administrative officer, proper evidence and an understanding, sympathetic court is necessary in most cases. Geography and politics may have some bearing in bringing to conclusion, seed cases. Through a study of law I have ascertained that courts do not like minimum fines. This matter seems to be a legislative invasion of the rights of a judiciary to exercise discretion in the matter and according to the evidence. Many laws now in existence have minimum fines. I wonder if most of us have not bent over backwards in our so-called educational program until it is detrimental both to the dealer, the public and the administrative program in general. It is rather difficult to understand why the public understands the necessity of having an automobile and hunting license and yet at the same time does not understand other rules and regulations as required by a seed law.

Little education has been used to get one to pay the income tax and certainly the information has been small in comparison to getting seedsmen to label and farmers to understand what the label symbolizes. It seems to me that we have gone far enough in our educational program and that we should straighten up and adopt severe means causing dealers, truckers, and farmers to understand the requirements of the seed law. The excuses which we have received in Ohio over a considerable period of time are not unlike those which you have received. It is this rather unstable situation that has prompted a number of administrative officials including myself to desire an open discussion of ways and means to get better enforcement, in other words to make the Seed Law work.

Although we have not answered all the problems (technical) we have made considerable progress in laboratory procedure and in recommendations for uniform labeling requirements. I am wondering whether we have gone far enough in considering how to make the seed law work in its practical application to the business of regulating the trade. It has come to me from the trade that the treatment received in two states on exactly the same set of facts varied considerably. Stabilizing our procedure in collecting evidence undoubtedly will materially assist in getting quicker action on interestate shipments. Legally we speak of the corpus delicti or the body of the crime without which no case can proceed. Getting the sample or the information on time, place of shipment and all facts relating

to the transaction is the corpus delicti of the seed law. Some inspectors feel that it is only the analyses that counts and fail to understand the more evidence and data collected greatly enhances the possibility of getting a conviction and that he likewise is required in obtaining his sample to follow procedure recommended insofar as is possible the time, place, and local conditions.

Analysts might well understand that laboratory procedure in and of itself is insufficient to make a case. It is necessary to prove an offering or exposing for sale with dates, times and places. Each phase of the work is just as important as any other and it usually takes all of the evidence to make the case stick. I realize that the Association can do little at this time beyond discussing some of the problems. These may be considered in the light of the following questions:

1. What is the minimum violation to be considered as the basis of prosecution?

2. Upon what labeling requirements should the greatest emphasis be placed--such as varietal purity, mechanical purity, noxious weeds or germination?

3. Does the tolerance serve as a guide to this question?

4. What constitutes offering seeds for sale? In some states it is said to be advertising, in other samples. It has been held in Ohio that the seed itself must be in evidence.

5. Should the state go to the expense of having a hearing previous to prosecution? Does not this delay, or open the way to meddling--political or otherwise? Do you have hearings for violations of Dairy and Food regulations such as sulphiding hamburg, water milk, diluted vinegar or fish and game regulations. I fail to know of any such regulations in Ohio.

6. What about news releases on cases which come before the department? Are these hushed up? If so, why? Sometimes this is the most effective weapon that can be used.

7. I am wondering if closer relations between states concerning interstate shipment might not greatly facilitate the finding, locating seed sold by questionable dealers?

8. What legal effects have rules and regulations? In some states they are held to be law and in others only to administrative procedure.

9. In a case a hearing is provided for are the rights of the defendant safeguarded?

10. What are these safeguards?

11. Again the question of access to places of business, reasonable hours for inspection are perhaps variable.

12. What about civil and criminal liability?

13. Are the penalties such as suspended fine cumulative on misbehavior?

14. How does the Federal government look upon such suspended fines?

15. What is the nature of the evidence required and absolutely the minimum necessary under federal and state procedure?

16. What about the relation of principle and agent as to the responsibility for labeling?

17. Does intent need to be proved?

18. To what extent is original package or container required to be introduced as part of the evidence.

19. What is the standing of the certificate of analysis in court?

20. What is the ruling of validity of standards?

21. What is considered reasonable punishment?

22. Who generally prosecutes your cases in court?

23. Must the analysis be considered as a truthful statement?
24. What is the right to cross examine the analyst?
25. What is the right of a trial by jury? These references are perhaps only some of the problems that have been unanswered in your mind. A full discussion is in order. It may be desirable to consider the questions somewhat as they have been presented in the light of your experience. M. T. Munn of New York has presented direct reference to rulings in New York state which will be cited to some of these cases reviewed or abstracted or incorporated periodically in the News Letter and any references which come up in the future will be carried in the same medium. It is this interexchange of rulings and cases that would help to keep us up-to-date in this important phase of seed work.

The production of seed is a matter of public interest and proper subject for investigation, encouragement, development and regulation.

Matters of public interest and of state regulation. Abounader v. Strohmeyer and Arpe Co., 217 A. D. 43; affd. 243 N. Y. 458.

Publication of rules may be necessary to give them full effect of law.

Publication essential to validity of rules and regulations. Op. Atty. Genl. (1927) 302.

Access to place of business.

Commissioner or any of his duly authorized representatives may enter building where seeds are, for purpose of inspection of materials or premises. Op. Atty. Genl. (1927) 65.

Penalties for violation of seed law.

Civil as well as criminal liability. People v. Beaman, 102 A.D. 151.

Cumulative penalties. People v. Spencer, 201 N. Y. 105; People V. Koster, 121 A. D. 852. People v. Abramson, 208 N. Y. 138.

When part of a penalty or forfeiture may be recovered. See 1182, Civil Practice Act.

Nature of the evidence.

Principal bound by act of driver as his agent. People v. Hills, 64 A. D. 584.

Bound by sale by clerk. People v. Lewis, 138 A. D. 673.

Criminal knowledge or fraudulent intent immaterial to constitute offense. People v. Shields, 142 A. D. 194.

Intent need not be shown. People v. Eddy, 59 Hun, 615, following People v. Cipperly, 101 N. Y. 634. People v. Schaffer, 41 Hun, 23.

Intent immaterial. People v. West, 106 N. Y. 293. People v. Kibler, 106 N. Y. 321.

Analysis must be made from fair sample, otherwise defendant permitted to testify. People v. Salisbury, 2 A. D. 39; affd. 151 N. Y. 663.

Analysis alone sufficient to show violation. People v. Thompson, 60 Hun, 582.

Analyst's certificate presumptive evidence. People v. Eddy, 59 Hun, 615.

Definitions.

Law prohibiting sale of seed below standard constitutional. People v. Bowen, 182 N. Y. 1, revg. 97 A. D. 642.

Where the fairness of the sample is not in question, evidence that seed has not been tampered with is incompetent. People v. Laesser, 79 A. D. 384.

Complaint pleading violation should be specific. People v. Steinbeck, 186 A. D. 26.

Facts should be pleaded according to their effect, not as evidentiary facts. People v. Woodbeck, 55 A. D. 277. Also see 241, Civil Practice Act.

Truthful statements on packages.

Statement on package as to contents and analysis means truthful statement. People v. Down, 176 A. D. 282, 285.

Evidence as to whether defendant offered commodity for sale. People v. Jamestown Electric Mills, 184 A. D. 962.

Refusal to allow access to premises.

Refusal to allow access for inspection may incur revocation of license. Op. of Atty. Genl. 1927, p. 65.

INTERNATIONAL ANALYSIS CERTIFICATES PROVE EFFICIENT.[1]

Bette Cullinan

New York State Agricultural Experiment Station, Geneva, N. Y.

The International Analysis Certificate devised to be used in connection with the International Seed Testing Rules and to accompany shipments of seed in international commerce has proved to be especially efficient and helpful in expediting seed shipments in the present emergency.

During the past season, at the seedsmen's request, nearly 200 of these international certificates have been issued from our laboratory to meet foreign seed demands, likewise a few have been received with importations. Coincident with the using of these international certificates there have been at least ten opportunities to compare and explain real differences between findings on the market-sampled stock and the vendor's labeling as based upon a previously obtained laboratory certificate.

It seems quite appropriate then to compare the relative usefulness of these complete certificates with the meager seed analysis and test reports frequently received in connection with claims of irregularities or reports of difficulties in local law violation. These complaints, particularly where interstate shipment is involved, are frequently accompanied by proof in the form of an analysis certificate which gives incomplete information. For example, among certain cases investigated, one laboratory had issued a certificate showing "no noxious weed seed present," yet had based their finding upon a sample of seed grain of less than 100 grams. In other cases no examination for weed seeds had been made beyond the test or working sample. These commercial analysis certificates seemingly bear no semblance of uniformity in context or makeup as would seem to be desirable from even a commercial standpoint. All of these unwarranted and unnecessary deficiencies are largely prevented when the international certificate or its equivalent requirements are followed. With the international certificate one knows that the information recorded is entirely complete and that the analysis and tests are made in accordance with the international rules and one has a fairly complete record of what has been done and upon what size of sample the information stated is based.

The analysis certificate issued is the only tangible evidence of the ability of a seed testing laboratory to adequately appraise a seed stock, and is the only visible record of the work done. When a laboratory accepts a sample for any form of determination it assumes a responsibility and what it reports to the sender should be well founded upon facts and clearly state all pertinent information on the report or certificate. Otherwise, analysis certificates used in commercial transactions lead seedsmen into a sense of false security or unwarranted assurance. A report showing the noxious weed seed item blank or making no provision for it at all may mean that either there were none present in the test sample or the entire sample or that no examination was made for noxious weed seeds. In trading the tendency is to use such a certificate on the basis that there were no noxious weed seeds present, yet neither the analyst nor the tradesman have protected themselves against later challenge of their representations. Why would it not be better for the issuing laboratory to stamp or add a note to the certificate plainly showing "No examination made for noxious weed seeds"? If an examination was made then the required minimum

1. Journal Paper No. 577. New York State Agricultural Experiment Station, Geneva, N. Y.

size sample should be used. By the same token would it not be quite prudent for every laboratory, even at the risk of appearing to be too cautious, to refuse to issue a report as to any finding unless the sample used was really adequate. Some seedsmen seem prone to submit a small sample.

Differences in germination test values reported probably give rise to as much dispute as do weed seed determinations. Presumably laboratory tests for germinability should be made under optimum conditions and the standardized test period employed. Whenever seeds required special treatment and such was used that fact should be stated on the certificate. Hence, if variations should occur one can quickly learn how the germination test was conducted. Sometimes it is not possible to assist very much in explaining or understanding difference in findings upon a seed stock because very often only a certificate of a germination test is offered and without any reference to the mechanical purity upon which it was obtained.

Observations made during the past year that the longer germination test period required by the international rules gave appreciable increases in germination in only a low percentage of instances. This longer test period might, however, be of value when testing newly harvested seed.

At this time when there is an increased demand for quality uniformity and reliability from year to year, particularly on the part of the crop improvement associations and the discriminating buying public, would it not be quite appropriate for the association to seriously consider, possibly with the uniform tag as a basis, some form of uniform, more or less complete certificate of analysis and test, certainly in all cases where it is known in advance that the seed stock being described is to pass in interstate commerce.

WEED TRENDS IN RED AND ALSIKE CLOVER SEED SINCE 1911[1]

Leroy Everson

New York State Agricultural Experiment Station, Geneva, N. Y.

Man has been responsible for the introduction and spread of three-fourths of our troublesome weeds. A large percentage of this spread has been through the sowing of unclean seed stocks. True it is that the sowing of clean seed alone is not adequate to control weeds now that they are established here, yet we must bear in mind that unclean seed lots are the means of the dissemination of weeds between counties, states, and nations.

The annual loss due to weeds approximates one-third the value of all farm crops produced during a year.

Records of the occurrence of the most prevalent weeds in New York grown red and alsike clover seed lots reveal some interesting and significant trends in our well known weeds. Records of occurrence of certain weed seeds were tabulated back to the year 1911. Some significant and typical trends are here shown in tabular form.

1. Journal Paper No. 578, New York State Agricultural Experiment Station, Geneva, N. Y.

TABLE 1. - Record of Occurrence of Five Prevalent Weed Seeds Found in Red Clover Seed and the Percentage of Stocks in which they Occurred by Years.

Weed	1911	1921	'23-'24	'25-'26	'27-'28	'31-'32	'33-34	'35-'36	'37-'38	'40-'41
	%	%	%	%	%	%	%	%	%	%
Buckhorn plantain	64	77	93	79	90	95	94	97	83	73
Common Ragweed	14	27	21	22	50	44	35	71	81	73
Green bristlegrass	59	62	60	51	71	87	75	86	70	55
Wild carrot	8	42	40	57	69	75	37	50	67	50
Curly dock	58	30	16	13	20	14	20	17	43	28

This tabulation shows that buckhorn plantain, green bristlegrass and curly dock have remained quite constant over the last 30 years and were probably introduced here long before 1911. Wild carrot infestations in the fields of New York State have been largely built up since 1911. Common ragweed, relatively insignificant before 1911, is now spread over the country as never before and ties with buckhorn plantain in the number of lots in which it occurs. It is little wonder that New York State supplies a big share of the two million people afflicted with asthmatic conditions. Few realize that 73 per cent of the fields sown to red clover, or a calculated half of our cultivated land, is sown with this pest.

TABLE 2. - Record of Occurrence of Six Prevalent Weed Seeds Found in Alsike Clover and the Percentage of Stocks in Which they Occurred by Years.

Weed	Year 1911	1921	1926-27	1931-32	1940-41
	%	%	%	%$	%
Buckhorn plantain	32	60	80	84	
Yellow rocket	0	35	50	80	
Sheep sorrel	57	57	40	46	
Catchfly (N.B.)	38	21	24	44	
Oxeye daisy	1	30	32	34	
Curly dock	44	18	16	40	33

This tabulation again shows that buckhorn plantain, sheep sorrel, night blooming catchfly, and curly dock have remained quite constant as contaminants. Yellow rocket shows an increase from 1911 about the time of its introduction into New York State to its place with the most prevalent weeds in the state. Oxeye daisy shows a much slower but similar advance since 1911. Farm to farm surveys in 1940 and 1941 confirm the figures given in these tables.

The seed analyst can do much to prevent the introduction and spread of undesirable weeds since he is the first to find its presence in imported seed. Stocks of crop seed from other states and countries found to contain new weed seeds should be checked thoroughly. More than records should be kept of weed seeds which have been brought in and which might prove a menace in the future. The seed analyst is, and must be, the first line of defense against weed seeds.

ANALYSIS OF SEED WITH THE RICE LABORATORY SEED CLEANER - PRELIMINARY TESTS[1]

W. O. Whitcomb and Bertha B. Thompson

Montana Agricultural Experiment Station, Bozeman, Montana

Samples of seeds which contain excessive amounts of foreign seeds or other material often require much time for purity analysis. It was for the purpose of reducing this time that a study was made of the Rice laboratory seed cleaner for seed analysis work. This cleaner was designed primarily for removing dodder from clover and alfalfa on a commercial scale.

Construction of the Cleaner

The Rice laboratory seed cleaner is of simple construction and consists of two rolls set parallel in a box and at an angle of 2° from the horizontal. They are 21 inches long, 3 inches in diameter, and are covered with a finely textured pile fabric. These rolls are held firmly together by means of springs. The movement of the rolls is away from each other so that when the seed is deposited at the upper end, the cleaned portion gradually moves to the lower end and out through a spout, while seeds and other material which have a rough surface adhere to the fabric and are carried over and deposited under the rolls in a long tray.

The original design of the cleaner was changed so that three drawers with dimensions of 5 1/2 by 7 inches and 1 3/4 inches deep were substituted for the long tray. The material which is carried over by the rolls is deposited in these drawers and can all be recovered. The drawers also facilitate the separation of the material which is found in varying grades in each.

Different Tests in Cleaner

Six lots of seed were selected for comparing the time required for analysis by the regular and the Rice cleaner methods. Notes are given with each relative to how they worked in the cleaner.

No. 25468. Mixed alfalfa and sweet clover - Contained a high percentage of foreign seed and small, hard lumps of gumbo. Some of the sweet clover and all of the gumbo were removed by the cleaner.

No. 8798. Mixture of timothy and alsike clover - Not many foreign seeds were present - Much of the timothy was removed by the cleaner. Timothy with hulls on was readily removed from alsike clover.

No. 25495. Alfalfa - Contained broken seeds and considerable dodder and other weed seeds. Broken seeds of alfalfa were readily removed by the cleaner.

No. 8590. Sweet Clover - Contained high percentage of broken seeds. These broken seeds were practically all removed by the cleaner.

No. 8634. Flax - Contained 7.42% broken seeds and but few weed seeds. It was necessary to run the seed through the cleaner several times in order to return to the sample the unbroken seeds of flax which slipped down between the rolls. However, the broken seeds of flax were readily removed.

---

1. Contribution from Montana State College, Agricultural Experiment Station. Paper No. 172, Journal Series.

No. 8635. Flax - Contained 8.50% broken seeds and 3.60% weed seeds (wild sunflower, fanweed, and hare's ear mustard.) In addition to the broken seeds of flax which were removed, these weed seeds were readily removed.

Material which can be removed by cleaner

It was found that the following material could be removed readily by the cleaner:

1. Broken seeds of alfalfa and similar seeds.
2. Timothy and other grass seeds which have the glumes present.
3. Weed seeds with rough seed coats, such as lambs quarters, foxtail, etc.
4. Particles of gumbo.
5. Any other material having a rough surface.

The Following Material could not be Removed by the Cleaner

1. Red-root pigweed seed and other seeds having a smooth surface.
2. Crop seeds such as timothy from which the glumes have been removed and the millets. This applies especially to the proso millets, either with or without the glumes.

Seeds like wheat and the rough seeded grasses, which have a rough surface, were not satisfactorily analyzed with the cleaner.

TABLE 1. - Comparison of time required for purity analysis by regular method and by Rice seed cleaner.

Sample No..	Kind of seed	Method	Time in minutes			
			Separation pure seed[1]	Separation inert and foreign seed	Total	Time saved by Cleaner Method
25468	Mixed alfalfa and sweet clover	Regular	30[2]	25	55	
		Cleaner	20	25	45	10
8798	Mixed timothy and alsike clover	Regular	30	4	34	
		Cleaner	21	2	23	11
25495	Alfalfa	Regular	22	28	50	
		Cleaner	10	28	38	12
8590	Sweet clover	Regular	35	4	39	
		Cleaner	20	4	24	15
8634	Flax	Regular	10	2	12	
		Cleaner	10	2	12	0
8635	Flax	Regular	15	4	19	
		Cleaner	10	4	14	5

1. Separation of pure seed means that this portion of the sample was separated from the inert matter and foreign seed and the percentage of such pure seed was computed.
2. The time required for the separation of the sweet clover from the alfalfa was not included in this time.

Time Saved by Use of Cleaner

As shown by the data in Table 1, an appreciable amount of time was saved by the use of the cleaner. A saving of ten minutes was made on a sample of mixed alfalfa and sweet clover which contained gumbo. Eleven minutes was saved on a mixture of timothy and alsike clover. Alfalfa which contained considerable broken seeds and dodder showed a saving of 12 minutes. A saving of 15 minutes was noted on a sample of sweet clover which had a high percentage of broken seed. No saving was made on a lot of flax which contained a high percentage of broken seeds and but few weed seeds. A saving of 5 minutes was made on a sample of flax which contained a rather high percentage of rough weed seeds.

Adaptability to Uncleaned Seeds and Screenings

Seed testing laboratories are sometimes requested to analyze samples of uncleaned seed or screenings as to content of pure seed and its viability. Work of this kind often requires much time, but when this cleaner is used, the time can be reduced considerably.

Summary and Conclusions

The Rice laboratory seed cleaner, which was devised for removing dodder from alfalfa and clovers, was used for analysis of a number of crop seeds. These preliminary results with six lots of seed warrant the following conclusions:

1. Broken seeds of alfalfa and the clovers, weed seeds having rough seed coats, and particles of gumbo can readily be removed by use of the cleaner.
2. Weed seeds having a smooth surface and millets (especially the prosos) cannot be removed by the cleaner.
3. Such seeds as wheat and the rough seeded grasses cannot be analyzed with the cleaner.
4. A saving of time in analysis of from 5 to 15 minutes was found when the cleaner method was compared with the regular method.

DALLIS GRASS SEED ANALYSIS

Myrta Susan Munn

Department of Agriculture and Industries, Montgomery, Alabama

Many problems of a perplexing nature come to our attention through actual trade practices. A seed dealer purchased a large stock of Dallis grass seed to sell to the farmers and retailers in his state. Wishing to comply with the state seed law, he sent a sample of this seed to a laboratory for analysis and subsequently used the information on the tags with which he labeled his bags of Dallis grass seed as sold.

All went well until one day the dealer received notice that his Dallis grass seed had been suspended from sale because of inaccurate labeling. The dealer had complied with the law to all intents but the label information which the laboratory had furnished to him was inaccurate. It would appear that in the laboratory examination the correct interpretation was not made of what should be considered as pure seed and what should be inert material when making the purity analysis of this particular kind of seed.

With Dallis grass assuming greater economic importance than ever; the imported seed supply uncertain at best in these times, and domestic Dallis grass seed becoming a more important item in the seed trade, it is doubly imperative that there be uniformity in procedure and results of analysis of this seed.

In Alabama, during the period from July 1, 1941 to April 20, 1942, there were 43 inspection samples of Dallis grass seed submitted to the seed laboratory for test. Of these samples, 21 were domestic stocks, 21 of Australian origin, and 1 was of unknown origin. The stock of unknown origin was found to be correctly labeled as to percentage of pure seed and of inert matter; 16 were found to be correctly labeled as to percentage of germination; 3 were found to be slightly outside the allowable tolerance but were not considered to be misbranded; 1 sample was found to be misbranded in all respects.

The 21 domestic stocks presented an entirely different picture since all were misbranded as to percentage of pure seed and inert matter and all were found to be higher in germination than labeled. The differences in the percentage of pure seed, as labeled, and the percentages as found, ranged from 18.23 to 71.66%. Increases in the percentage of germination ranged from 4% to 48%.

A further need for consonance in analyses of Dallis grass seed is indicated when it is realized that at present the approved method of ascertaining the true worth of a lot of this seed is by the determination of its pure live seed content. It does not seem feasible to apply the tolerance for pure live seed in the enforcement of the law, since it seldom occurs that more than one item (i.e., purity or germination) is found to be in extreme variation.

Comparative Analytical Work

In an effort to determine the factor or factors contributing to the lack of uniformity in results obtained by the various laboratories in the analysis of Dallis grass seed, two reference samples identified as "A" (Australian grown) and "D" (Domestic grown) representing two uniform bulk samples were prepared and sent to 46 official and 14 commercial seed laboratories for comparative analysis.

Laboratory Procedure, - Alabama

As a basis for consideration and comparison 12 samples of each of the two lots were completely analyzed in the Alabama laboratory. In doing this two different types or makes of blowers or air blast separators were used with apparently equal or like results. In making these analyses all of the obviously diseased florets, that is, those dark, salmon colored, misshapen, gaping glumes easily recognized with the unaided eye as well as all of those which appeared black over reflected light and were not firm to the touch when pressed with the forceps, were removed as inert material. The percentages of inert matter, pure seed, weed seed and crop seed present were finally computed. From the pure seed separation 4 x 100 seeds were counted, planted on a substratum of cotton and filter paper moistened with KNO_3 in petri dishes and placed in a daylight germinator at 35°C for 9 hours, and in a dark germinator at 20°C for a period of 15 hours.

Experimental Results and Discussion

The results of the analyses made in the Alabama laboratory and those of other laboratories participating (16 official and 7 commercial) were treated statistically, however the percentages of weed and crop were omitted from consideration in this instance as not being of great significance.

Using the chi-square test it was found that Lot "A" was homogenous. Chi-square was found to be .0044 showing that the differences in the results of the 12 tests made on Lot "A" in the Alabama laboratory were much less than the expected differences when working with biological material. This would indicate that the method used to ascertain the purity of Lot "A" when applied to other homogenous material would yield similar accurate results. The mean of purity was found to be 68.14% with a latitude of 70.74 to 65.79%.

By using the mean purity as a stable factor against which to check the results of analyses made in other laboratories, and employing the tolerance tables[1] it was found that of 23 reported results of Lot "A" only 4 were found to be significantly outside the allowable tolerance. The values used and their range are; maximum purity, 74.65%; mean purity, 68.14%; and minimum purity, 61.63%.

Of the 23 cooperating laboratories, 21 used some kind of blower in making the purity analyses; 2 laboratories used some form of reflected light; 13 laboratories used pressure to determine the presence of a caryopsis in each seed; 4 used pressure in some instances; and 7 reported that they did not use pressure at all.

Since the majority of laboratories reported purities within the latitude permitted upon this particular stock of seed it is indicated that they are making similar interpretations of what should be removed as inert material and what should be left in the sample as pure seed, regardless of the method used to arrive at the final purity percentage. With increased experience in the analysis of Dallis grass seed the results should be even more uniform.

The question of what should be considered as inert matter in Dallis grass seed in conformity to the rules was given special attention in the seed laboratory of the New York State Agricultural Experiment Station, where, according to their report an examination was made of 2-gram samples of both Lots "A" and "D" with the view of determining whether those heavy diseased seeds which occur in Dallis grass seed may be removed as inert matter under the definition as stated in the Rules and Regulations[2] i.e., "Broken seeds when one-half or less;.... empty glumes of grasses; attached sterile glumes of grasses (which must be removed from the fertile glumes except in Rhodes grass); dirt, stones, chaff, fungus bodies (such as ergot and other sclerotia and smut balls), and any matter other than seeds shall be considered inert matter." At that Station blowings were made of Lot "A" and the constituents of the blowings were separated, counted and weighed. There was found to be a total of 888 pure seed in the test sample with an average unit weight of .00169 grams, and 57 diseased seeds with an average unit weight of .00154 grams. A comparison of the unit weights showed that the diseased seeds were nearly as heavy unit for unit as the pure seed, therefore, they are greater in weight than one-half a pure seed, and as such, not removable as inert matter under the present rules unless it shall

1. Tolerance Tables to be used in Connection with the Enforcement of the Federal Seed Act. Sept., 1940. A.M.S. of the United States Dept. Agr.
2. Rules and Regulations under the Federal Seed Act. March, 1940. Service and Regulatory Announcements No. 158.

be construed that these badly diseased seeds are "fungus bodies" and in the same category as ergot sclerotia and smut balls.

In like manner a 2-gram sample of Lot "D" was separated and found to contain a total of 468 pure seed with an average unit weight of .001557 gram, and 411 diseased seeds with an average unit weight of .00162 grams. In Lot "D" it can be seen that the diseased seeds averaged heavier unit for unit than the pure seeds. It again holds true, under the present rules, that these diseased seeds cannot be removed as inert matter unless it shall be construed that these badly diseased seeds are "fungus bodies" and in the same category as ergot, sclerotia and smut balls.

C. L. Lefebvre, pathologist with the Division of Forage Crops and Diseases, U.S.D.A. has identified the black fungus growing from Dallis grass seed as belonging to the imperfect fungi and as Cerebella andropogonis Ces. The Fusarium found growing on the seed was identified as probably Fusarium heterosporium. Since this imperfect fungus does not seem to be found unless the honey-dew stage of ergot is first present and the Fusarium is also often found as a pinkish-red growth on the honey-dew stage of ergot, it would seem logical that these diseased seeds may be construed to be fungus bodies and, therefore, removable as inert matter, but if such is done it must be generally understood and so ruled by the Association in order that all may work alike.

As regards viability there was a considerably greater variation in the reported percentages of germination than there was in the purity of Log "A". Here again the factor from which to check the total variation was arrived at by the application of statistical methods. The 12 tests made by the Alabama laboratory were found to be well within the expected deviation from th standard. Therefore, the mean germination of the 12 tests was accepted as a "true" value against which to check the test results from the other laboratories. Applying the tolerances for germination as given in the Rules and Regulations, 11 of these reported results were found to be below the allowable tolerance and of these, 8 were significantly below and 3 to a lesser degree. The values used and their range are: maximum germination, 89.23%; mean germination 82.23%; and minimum germination 75.23%.

In seeking an explanation of the low percentages of germination reported by these 11 laboratories, a survey of the germination conditions used revealed that 7 of the 11 laboratories reported that they did not have the recommended temperature and or light conditions. On the other hand, 6 of the 12 laboratories reporting germination results well within the tolerance also reported that they do not have the recommended temperature and/or light condition for making the tests.

The mean percentage of pure live seed was found to be 56.0% with a latitude of 46.36 to 66.61%. This latitude embraced all but 7 of the 23 reported results. Three of these were only slightly outside the tolerance, the remaining 4 were significantly outside. These 7 samples were also outside the allowable tolerance for germination, and 3 of them were outside the tolerance for pure seed.

Lot "D": The method by which the purity analyses of Lot "D" were made has already been mentioned. Using the chi-square test, Lot "D" was found to homogenous; therefore, the mean purity of the 12 tests made on this lot of Dallis grass seed in the Alabama laboratory was accepted as a "true" value, and the tolerance latitude for the other tests derived from it.

By applying the tolerance as given in the tolerance tables previously referred to, 15 samples, according to the results reported were found to be outside the allowable tolerance; 14 significantly so, and 1 only very slightly so. The values used and their range are: maximum purity, 30.87%; mean purity, 25.38%; and minimum purity, 19.89%.

Since only 7 (8, if the one result which is only slightly outside the allowable tolerance is accepted) of the 23 reported analyses were found to come within the tolerance, it is indicated that Lot "D" presented a greater problem in interpretation between inert matter and pure seed. However, since seed of domestic grown Dallis grass seed which this represented is becoming more common on the market and will be sent with increasing frequency to laboratories for analysis, it is imperative than an acceptable degree of agreement in interpretation of the various constituents be attained, and that the results show a greater conformity than was demonstrated by these results.

The variation in percentages of germination reported for Lot "A" which was a "good" sample, were fairly numerous, and Lot "D" which might be expected to yield greater divergencies in percentages because of its inferior quality, held true to the expectations.

Applying the tolerances found in the tolerance table, using the mean germination of 61.70% for Lot "D", one finds that of 23 results reported by laboratories 19 were outside the allowable tolerance; 17 significantly so and 2 slightly so. As to the extreme variance in germination results reported, no explanation is ventured. The germinative conditions under which Lot "D" was tested, were presumably the same as for Lot "A".

The mean pure live seed content was determined to be 15.67% with a range from 21.83 to 10.48%. Only 9 of the 23 results were found to be outside the allowable variation. In two of these cases the reason for the low pure live seed percentage may rest with inadequate germination conditions since the corresponding purity percentage was within the latitude of allowable variation.

Finally, the results reported by the various seed testing laboratories participating in this comparative study were collated, tabulated and distributed to each participant so that they could study the entire range of results secured and compare them with the results obtained by their work.

CONCLUSIONS

There are certain definite conclusions which can be drawn from this work with Dallis grass seed.

1. There is a vital need for uniformity in exact procedure in purity analysis of this kind of seed.

2. The question of the proper and uniform disposal of diseased seeds when making the purity analysis must be clarified, decided upon and then made plain to all workers alike by a definite rule as to whether or not these are fungus bodies and as such are to be classified as inert matter.

3. It was demonstrated that purity analysis with a fairly high degree of accuracy and uniformity can be made when a definite rule is followed.

4. The need for adequate laboratory facilities and germinators to carry out the proper germination test procedures is plainly indicated.

TREATMENT OF MULTIPLE FLORETS

R. H. Porter

Iowa State College, Ames, Iowa

The basic method for the analysis of small seeded grasses using controlled air pressure as developed independently by C. W. Leggatt and the writer is applied in slightly different ways but is fundamentally the same and gives similar results when applied in practice. In a paper now in press entitled "A New Concept of Pure Seed as Applied to Seed Technology" by Porter and Leggatt the authors have outlined in detail how the method is applied. The Canadian procedure requires only one opening (standard) for five minutes whereas the Iowa procedure for several grasses requires two or more openings from low to high (standard) pressure.

When the Iowa procedure is applied to bluegrass seed a few firm seeds are found in the material removed at the top pressure and some multiple florets each containing one firm seed frequently remain in the heavy fraction. Such florets are more common in lots below 21 pounds per bushel. The presence of 50 such florets in a one gram sample is equivalent to about 1.5 per cent by weight. The Iowa Method for orchard grass provides for an arbitrary division of the weight of such florets into 4/5 pure seed and 1/5 inert matter. For bluegrass it has been found that approximately 2/3 the weight of the heavy multiple florets may be considered as pure seed and 1/3 as inert matter. The presence of 50 heavy multiple florets in the pure seed fraction of bluegrass, if treated as suggested, would mean that 0.5 per cent would be added to the inert matter fraction and the same amount subtracted from the pure seed fraction. This is such a small amount that the procedure used is to make no correction unless the number exceeds 50 in which case they are separated, weighed and then replaced in the pure seed. The calculation of pure seed is made by adding 2/3 and 1/3 the weight of such florets to the pure seed and inert matter fractions respectively. Uniform results with the Iowa air blast separator using the standard setting may be expected if the disposition of the heavy multiple florets is made as herein outlined.

EXPERIMENTS IN THE DEVELOPMENT OF BLUEGRASS SEED

E. N. Fergus

Kentucky Agricultural Experiment Station, Lexington, Kentucky

Average yields of Kentucky bluegrass seed during the past 25 years in the Kentucky-Ohio bluegrass-producing area varied from 4.7 to 13.5 bushels per acre, and the "clean-out" percentage of rough-cured seed varied from 22 to 69. Acre yield and clean-out percentage are closely correlated; therefore it appears that, for the most part, the factors determining yield also determine the quality of the rough-cured seed.

Studies of random samplings of the 1940 and 1941 seed crops, both having low clean-out percentages, show that the "seed" could be classified in eight distinct "types." Three of these had aborted florets, in two others the ovary was slightly developed toward a caryopsis but little or no endosperm had developed, the three remaining "types" were fully developed caryopses but varied in the hardness of the endosperm. Percentages of each type varied from lot to lot and from plant to plant.

In 1941 only 22.5% of the plants examined produced caryopses with uniformly hard endosperm, and 72% of the florets studied produced no fully developed caryopses. Of the individual plants studied during the two years, one produced no caryopses with completely hard endosperm, whereas 75% of the florets of another produced such caryopses.

Causes of variations in floret development appear to be both environmental and hereditary in nature. Among the former it seems that soil productivity, soil moisture, insects and diseases are important.

SNOW-ON-THE-MOUNTAIN (EUPHORBIA MARGINATA) SEED DATA - A RAPID METHOD OF DETECTING VIABILITY[1]

C. E. Heit

New York State Agricultural Experiment Station, Geneva, N. Y.

Several samples of Snow-on-the mountain (Euphorbia marginata) have been received at the Geneva laboratory during the past two years for testing. When the seed was tested under normal germinating conditions a few seeds usually responded but most of the seed remained firm even after 2-3 months in the germinator. These firm seed often run as high as 80 per cent. Little information is available on the germinative characteristics of this species. Hottes (3)[2] reported that this annual self-sows readily and when planted the seed should be sown early in the spring. Bodger Co., (4) recommended a laboratory germination in petri-dish at 20-30°C for a period of 19 days but stated that more data needs to be collected on this species before a standard method is adopted. None of the lots tested by the writer during the course of this study responded sufficiently to these conditions to give an accurate viability per cent of the various seed stocks. Consequently, all of the stocks received at the laboratory have been examined by the writer and various seed data have been collected besides various germination techniques and seed treatments have been attempted in order to secure a means of determining the accurate viability per cent. The pure seed per cent was very high in this species the average being 99.82% for 9 lots. The number of seed per pound was uniform, varying from 29,800 to 32,600 with an average figure of 31,370.

In preliminary studies seed was placed under all available temperatures, on various substratums, and under various light and moisture conditions but none of these factors influenced germination or broke the apparent dormancy of the seed. Sulphuric acid treatment was tried without success. Moistening the substratum with a 0.2% solution of KNO_3 alone did not increase germination but it will be noted in Table 2 that it did influence germination materially when used in a combination with a prechilling treatment.

Due to the dormant nature of the seed, various prechilling treatments were tried for all lots received and the results secured are presented in Table 1. Longer and shorter periods of prechilling were tried other than 30 and 50 days as presented in the table, but they were less effective.

It can be readily seen that approximately 50 days prechilling was necessary to overcome all the existing dormancy while highest results were

1. Approved by the Director of the New York Agricultural Experiment Station for publication as Journal Paper No. 575.
2. Numbers in parentheses refer to literature cited.

TABLE 1. - The Effect of Various Prechilling Treatments on the Laboratory Germination of Snow-on-the-Mountain seed

No treatment			Prechilled 30 days at 3°-5°C. Substratum moistened with				Prechilled 50 days at 3°-5°C.					
			H_2O		KNO_3		H_2O		Firm seed left	KNO_3		Firm seed left
	Days		Days		Days		Days			Days		
Lot	10	60	5	10	5	10	5	10	No.	5	10	No.
	%	%	%	%	%	%	%	%		%	%	
A	12	12	63	63	72	75	82	83	9	91	91	2
B	5	5	29	29	43	44	42	43	14	47	49	0
C	5	5	29	29	28	29	33	35	8	38	41	0
D	13	14	24	24	38	40	76	78	12	84	86	2
E	7	7	17	18	48	50	65	67	27	94	94	1
F	3	3	6	6	18	18	37	38	32	46	47	14
G	16	16	51	52	71	71	60	61	30	90	90	4
H	20	20	43	45	48	50	47	49	26	70	71	3
I	42	42	48	49	81	84	78	78	16	91	92	3
Ave.	14	14	34	35	50	51	58	59	19	72	73	3

secured with seed prechilled for 50 days and the substratum moistened with a .2% solution of potassium nitrate. The beneficial effect of potassium nitrate was noted in nearly all lots of prechilled seed regardless of the length of the prechilling period. Also, the data shows that seed germinate promptly, usually within five days, if they are properly after-ripened and ready to germinate. Germination does not lag and extend over many days. It can be seen in the check lot that no more seed responded after 60 days than had germinated in 10 days and the same characteristic was true of the prechilled seed although the data is not presented. The effect of lower or freezing temperatures during the prechilling period have not been attempted to date.

Preliminary results on the excising of embryos of this species were reported by Heit and Nelson (2). Since that report, records have been kept on the viability per cents obtained by various methods and the results are presented in Table 2 for comparison. These figures clearly show that very few of the seed germinate under the ordinary method as recommended by Bodger as only an average of 13% was obtained as compared with an average of 74% and 78% obtained by the optimum prechilling treatment and excision method respectively. It also shows that the results obtained by excision of embryos can be relied upon as a quick, accurate method of determining the approximate viability of seed stocks of this species when not enough time is available for a prechilling treatment.

Flemion (1) has described various techniques of excising embryos for many species. Heit and Nelson have also reported on several species and described environmental factors which might influence the activity of excised embryos and that KNO_3 and soaking the seed prior to excising the embryos stimulates activity in the naked embryos. These preliminary findings have been followed up by the writer and notes have been kept on all lots as to their embryo activity on various days with certain treatments. The response of these naked embryos are presented in Table 3 for three distinct treatments and the embryos from each of these treatments were

TABLE 2. - Comparison of Viability Results with Excised Embryos, - Optimum pretreatment and normal germination methods

Sample No.	Normal germination method (20-30 C, between blotters)	Prechilled 50 days at 3-5°C Substratum moistened with		Excised embryo method
		H_2O	KNO_3	
	60 days	10 days		(14-20 days Total*)
	%	%	%	%
1	12	83	91	90
2	5	43	49	45
3	5	35	41	46
4	4	78	86	86
5	7	67	94	91
6	3	38	47	61
7	16	61	90	92
8	13	31	74	88
9	20	49	71	89
10	42	78	92	94
Average	13	56	74	78

*This length of time also may include the soaking and prechilling periods in addition to the incubation period.

placed both in petri dishes on cotton and filter paper which was moistened with water and a 0.2% potassium nitrate solution. Only the average figures are presented for the ten lots as all were consistent in their behavior and averages will give a clear picture of the response without extensive data.

TABLE 3. - Response of excised embryos to various treatments. Average percentage at end of 10 days presented for a total of 10 lots treated as follows:

Classification of embryo response or activity	Seed soaked 2 days before excising		Seed soaked 7-10 days before excising		Seed soaked 2 days, then embryos prechilled 1 week at 3-5°C	
	Substratum moistened with		Substratum moistened with		Substratum moistened with	
	H_2O	KNO_3	H_2O	KNO_3	H_2O	KNO_3
(1) Normal seedling development	11	36	11	39	52	74
(2) Slight root activity or greening of cotyledons	12	12	17	20	17	6
(3) Firm and white (no growth)	55	31	50	19	13	4
Total Viability percent	78	79	78	78	82	84
(4) Non-viable (per cent decayed or brown)	22	21	22	22	18	16

The classifications of the embryo response are nearly self-explanatory as there are three fairly distinct conditions that occur with this species. In the first or normal seedling classification embryos appear almost like a regular germinated seedling although they are somewhat dwarfish in size. The second classification includes embryos which may vary tremendously in shape and activity, many appearing very abnormal, but they must be considered as viable. The third classification includes those which remain completely dormant and remain firm and white, some of them will remain this way for months without decaying. The fourth classification are those embryos which are dead or so weak that they cannot remain firm under these exposed conditions. From these studies the writer has found that a total of the first three classifications will give the approximate viability percentage and this correlates very closely with the properly after-ripened seed. The effect of the KNO_3 on increased activity in the embryos is plainly evident. The additional soaking of one week did not produce any great effect, although it is advisable to soak the seed at least 1-2 days for ease in excision over that of dried seed. Also, this short period of soaking did increase embryo activity over that of dry seed in the samples thus compared.

Prechilling the excised embryos for one week at 3-5°C was very effective in producing normal seedling development. The average total viability obtained by all these various methods and conditions were very consistent as can be seen in Table 3. From all these excision studies the writer believes it is somewhat safer and easier for the beginner to soak the seed two days at room temperature, then excise the embryos placing them in a petri dish on cotton and filter paper moistened with water, then prechill these embryos for one week before placing them at room temperature for development, after which the final reading can be made in 10 days. These conditions may be varied to individual tastes but this procedure is suggested because it gave increased embryo activity thus making it easier for the inexperienced to interpret results. There are occasional lots that show some browning of the cotyledons which makes it more difficult to diagnose where most of the embryos show no growth. Although the writer prefers potassium nitrate treatment it is not suggested for the beginner because developing embryos decay readily if conditions are favorable and these might be mistaken for dead seed. Although the removal of these embryos is time-consuming, 100 of them can be removed in 30 minutes after a little experience and the time involved is probably justified when a seedsman or grower is anxious to obtain a viability per cent.

All these laboratory results indicate that for optimum field germination the seed should be sown in the fall or, if not, very early in the spring to secure some after-ripening effect from the cold spring days. It is hoped that these results can be followed up with field plantings.

Summary

1. All seed stocks of Snow-on-the-Mountain (Euphorbia marginata) have exhibited seed dormancy.

2. The average purity of the lots examined was 99.82% and the average seed per pound was 31,370.

3. None of the lots gave satisfactory laboratory germination under any normal germinative condition. As low as 5%-12% germination was secured while 80-90% firm seed remained after 60 days in the germinator.

4. Prechilling the seed at 3-5°C for 50 days produced complete germination when the substratum was moistened with a 0.2% solution of KNO_3.

5. By excising the embryos an accurate viability per cent was secured in 14-20 days which correlated very closely to completely after-ripened seed.

6. The response of the excised embryos varied according to the method of treatment. A solution of KNO_3 on the substratum produced more normal seedling development and greening of the cotyledons while prechilling the embryos for one week stimulated the embryos greatest.

7. The excised embryos method is recommended in laboratory practice where not enough time is available to completely after-ripen the seed.

8. These laboratory results indicate that for maximum and complete field germination the seed should be sown in the fall.

Literature Cited

1. Flemion, Florence. Further studies on the rapid determination of the germinative capacity of seeds. Contrib. Boyce Thompson Inst. 11: 455-464. 1941.

2. Heit, C. E. and Nelson, Carrie. Approximate germination tests of dormant seeds by excising embryos. Proc. Assoc. Off. Seed Anal. 1941: 87-89. 1942.

3. Hottes, A. C. Practical Plant Propagation. A. T. Delamare Co. 1927.

4. Valuable Information for Seedsmen. Bodger Seeds Ltd., El Monte, Calif. 2nd Edition. 1935.

TOXICITY TO SEEDLINGS OF ZINC FROM GERMINATOR TRAYS[1]

Helen L. Munn and E. V. Staker[2]

New York State Agricultural Experiment Station, Geneva, N. Y.
and Cornell University, Ithaca, N. Y.

This paper deals with the nature, amount present, and the threshold of zinc from seed germinator trays constructed of galvanized wire cloth and usually supplied with some seed germinators.

Previous investigators (2)[3] (3) have reported upon the injurious action of zinc from improperly galvanized iron trays and have described the appearance of the abnormal seedlings from several kinds of seeds resulting because of the toxicity of this chemical as it became too abundant in the substratum. Chemical analyses of the blotters used as a substratum as well as the drip water and the wire cloth proved the presence of zinc.

No attempt will be made here to further describe the appearance of the injured and abnormal seedlings or list of kinds of seeds found to be sensitive to some degree, suffice it to say here that even after years of use both the inside of the experimental germinator itself (a type quite

1. Journal Paper No. 580, New York State Agricultural Experiment Station, Geneva, N. Y.
2. Formerly Laboratory Assistant, Division Seed Investigations, New York Agricultural Experiment Station, Geneva, N. Y., and Assistant Professor Soil Technology, Cornell University, Ithaca, N. Y., respectively.
3. Numbers in parentheses refer to literature cited.

commonly used and constructed of both galvanized iron and of copper), and the trays used yielded sufficient toxic material, particularly in the drip water of condensation from the top, to very noticeably and markedly affect seedlings of carrot, celery and lettuce which are rather sensitive.

In an attempt to determine the nature and amount of the toxic substance present in the substratum a score of the used seed germination blotters each 6 x 4 3/4 inches which showed these grayish white stains or streaks with a slick, metallic lustre were picked at random from the trays and along with unused blotters were analyzed. The zinc was determined in the following manner: All samples were first ashed in a muffle furnace at a temperature not exceeding 450°C. The period of ashing was about 12 hours. Pyrex beakers were used. At the end of this time the individual residues were dissolved in a 2 to 1 mixture of concentrated HCl and concentrated HNO_3 and evaporated to dryness on the steam bath. In each case a little water was then added to dissolve the soluble salts and the mixture adjusted to a pH of 4-4.5 using the glass electrode. The precipitated iron and alumina together with the silica were filtered off and the residue washed thoroughly with N/10,000 HCl. After evaporating the filtrate to dryness, the residue was taken up in .25 ml. of a solution of 0.1 N ammonium acetate of pH 46,0.025 N with respect to potassium thiocyanate. Oxygen was removed by bubbling pure nitrogen gas through the solution. The amount of zinc was then determined by means of the Heyrovsky polarograph using a dropping mercury electrode. The results were as follows:

Description of the material used	Micrograms of zinc as Zn per paper
Blue blotting paper substrates used in germinating carrot seeds and which showed contamination or effects of toxicity	Varied from 4,288 to 6,643 with an average of 5,736
Unused blue blotting papers from same stock or supply as a control or check	Varied from 37 to 78 with an average of 57
In another series of determinations the results were:	
24 blotting paper substrates used in germinating carrots and which showed streaks and stains and other indications of toxicity	Varied from 1,503 to as high as 8,837 with an average of 4,278
24 unused blotting papers from the same stock or supply used as control or check	Varied from 25 to as high as 114 with an average of 48
6 used blue blotting paper substrates but which showed no apparent toxicity or abnormal seedlings	Varied from 469 to as high as 1,996 with an average of 1,166

The Threshold of Toxicity to Zinc

Since the determinations indicated that blotters containing as much as about 1,500 micrograms of zinc as Zn caused toxicity to the carrot seedlings it seemed logical to next learn the threshold of zinc toxicity or to determine to what extent and to what point the amounts of zinc found in the blotting papers would affect germinating seeds. Solutions of anhydrous $ZnSO_4$ and distilled water were prepared in the following concentrations, namely 10, 100, 200, 300, 400, 500, 1,000, 1,500, 3,000 and 6,000 p.p.m. of $ZnSO_4$. Using a stock of normal, 90% germinating carrot seed a series of

germination tests were prepared using three different substrates, namely, germination blotting paper, paper toweling, and thin filter paper over absorbent cotton pads, all of which were placed in petri dishes and evenly moistened to their full water holding capacity with the prepared concentrations of $ZnSO_4$. These were then germinated in the usual manner at a 20-30°C alternating temperature in a dark germinator. At the end of 10 days final observations were recorded and photographs made of a typical series (Pl. 1, Fig. 1).

On the germination blotting papers at the lower concentrations no toxic effect was really apparent even at the termination of the test period. Beginning at a concentration of about 500 p.p.m. the seedlings appeared slightly stunted and the root meristems were, in many cases, browned. At 6,000 p.p.m. of $ZnSO_4$ only about 40% of the seeds ever showed any initial germination and at the end of 10 days these were practically killed down (Pl. 1, Fig. 1-A). The solution of 3,000 p.p.m. caused an intermediate degree of toxicity.

On the paper toweling as used in seed testing laboratories very definite toxicity appeared at 1,000 p.p.m. $ZnSO_4$ and progressed increasingly through the stronger concentrations to complete toxicity at 6,000 p.p.m. (Pl. 1, Fig. 1-B).

On the absorbent cotton pads or discs toxicity appeared at 200 p.p.m $ZnSO_4$ with a browning and stunting of a small number of seedlings at their initial germination, yet at the completion of the test period these seedlings had "outgrown" or "overcome" the effects of the $ZnSO_4$ and appeared quite normal. This seemed also true at 300 and 400 p.p.m. of $ZnSO_4$. At 500 p.p.m. definite permanent effect of the $ZnSO_4$ was observed and at 6,000 p.p.m. there was complete toxicity (Pl. 1, Fig. 1-C).

The differences evident in the toxicity response of the seeds on the three quite different types of substrata used may indicate different degrees of adsorption or of chemical precipitation of the zinc ions; or they may indicate differences in the ability of these materials to form complex ions with the zinc.

The Amount of Zinc in the Substrates

Now that it was known that on blotting papers, the test substratum usually used for carrot seed, the presence of 1,500 p.p.m. of $ZnSO_4$ would cause a toxic effect on carrot seedlings further determinations were made upon unused blotting papers and upon some used in germinating carrot, celery and lettuce seed. Also, along with these, other determinations were made upon papers used in the solution concentration tests, - upon normal carrot seedlings and upon carrot seedlings which were killed by the toxic material. The drip, in the form of condensation from the top of the galvanized iron germinator was collected along with some of the white salts rubbed from the germinator and were likewise analyzed for zinc. The results are as follows:

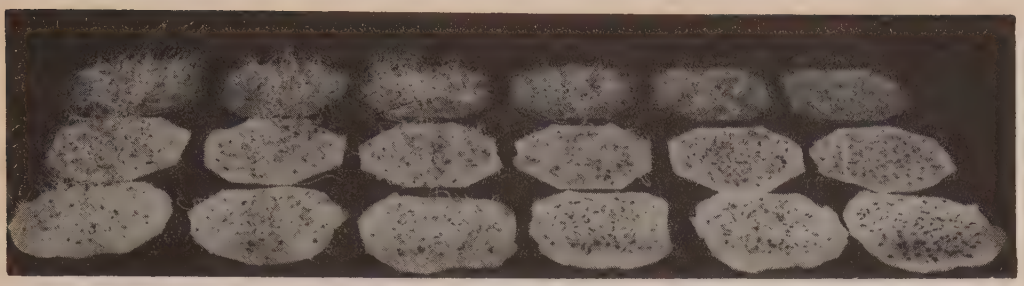


Figure 1. - Typical blotting paper (A-top row), filter paper (B-center row) and absorbent cotton (C-lower row) discs moistened with the respective concentrations of anhydrous $ZnSO_4$ as indicated and with the carrot seedlings growing upon them. Note the zone of demarkation showing effective toxicity running slantwise from the control on the cotton at the left lower corner to the upper right-hand corner where practically no growth has taken place on the blotting paper.

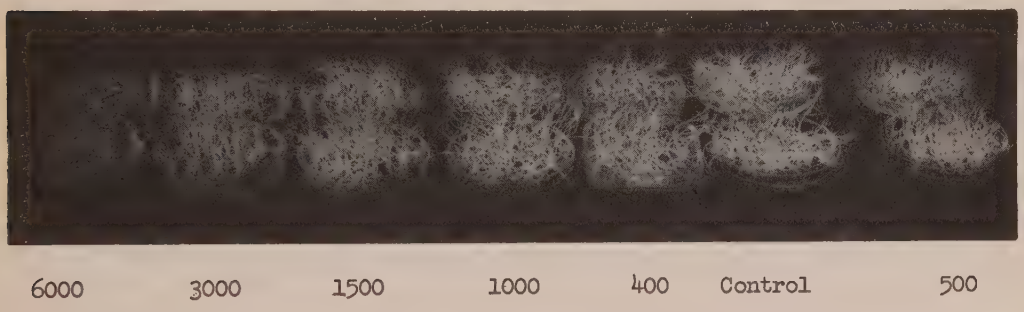


Figure 2. - Lettuce growing in petri dishes and upon blotting paper moistened with anhydrous Zn SO_4 in solutions containing p.p.m as indicated. Note that the series (extreme right) containing the 500 p.p.m. solution showed a marked stimulation. This is to be expected in view of the recent findings of the effect of certain minor elements upon plant growth.

Figure 3. - From left to right, lettuce, celery and carrot seeds germinating upon three of the blotting papers placed directly upon the galvanized iron trays precisely as directed in the directions accompanying the germinator. In the background are the seeds germinated in petri dishes so as to safeguard against possible toxicity from the trays. The white patches, or streaks of whiter, glassy, slick material upon the blotters on the trays are exceedingly toxic and may even prevent germination as is shown here.

Description of the Material Used in the Determinations	Percentage Zinc as Zn (Dry basis)
Blotting paper used once for germinating carrot	1.392
" " " " " " celery	1.011
" " " " " " lettuce	1.430
Blotting papers used in concentration tests when moistened with a solution of $ZnSO_4$ 500 p.p.m.	0.055
" " " 1,000 "	0.102
" " " 1,500 "	0.157
" " " 3,000 "	0.308
" " " 6,000 "	0.637
Normal carrot seedlings from normal blotters	0.0119
Carrot seedlings killed by toxicity	0.733
Residue of combined and evaporated "drip" solutions from	1.21
pH of combined "drip" solutions	5.40
White salts rubbed from old germinator	72.55

The Effect of Zinc Upon Seedling Development

Investigators, particularly Chandler (1), have shown that zinc is a necessary element for the growth of a variety of agricultural plants. Reed (5) in his study of the relation of zinc to seed production cites pertinent literature and refers to the work of Lockwood (4) who found that spore germination of Rhizopus oryzae was favored in the presence of zinc.

In the tests with concentrations of $ZnSO_4$ herein reported it was noted that when lettuce seed, a kind which develops seedlings rather rapidly, was grown upon substrata moistened with the various strengths of $ZnSO_4$ solution there was a threshold beyond which toxicity appeared yet just before that threshold there was a very definite and marked zone of stimulation. This appeared to be most pronounced in the series planted upon blotting paper in petri dishes and moistened with the 500 p.p.m. $ZnSO_4$ solution (Pl. 1, Fig. 2). The effect was expressed in the form of straighter, stiffer and greener seedlings. This should be expected in view of the recent findings regarding the relation of the microelements or rare elements such as boron, copper, iodine, manganese and zinc to plant production.

Some Experiments with Other Germinator Trays

Simultaneously with this work some trials were made with small galvanized iron or wire cloth trays taken from small germinators sold to seedsmen. All of those made of galvanized hardware cloth and especially where they were bound with a strip of galvanized iron showed definite degrees of toxicity varying from almost complete retardation of initial germination to only a slight toxic effect which one might easily overlook. An experienced technician might make the proper evaluation of the growth response of some of the seeds under test. There were other tests where it was definitely uncertain as to whether, or how much, the seed or the test substratum were at fault. The harmful effect seemed to depend largely upon the concentration of the toxic ion in the blotter, paper or cotton used (Pl. 1, Fig. 3). The remedy is plainly that of not constructing germinators, at least germinator trays, of this type of material carrying free zinc or other toxic elements.

Some Trials with Tray Paints and Painting

In addition to aluminum paint, white enamel and gray resin lacquer previously used and recommended, various paints such as those tested by Willits and Tressler (6) were used upon the various types of trays. Of the entire lot good lead-free aluminum paint evenly and well applied was nearly as satisfactory as No. 74 clear bakelite resin varnish which proved to be the best one tried. In any case the protective covering applied depended upon the care with which it was either painted, sprayed or dipped upon the trays and also their construction and also as to whether they bent, warped or cracked readily and thus allowed the toxic material to "bleed" through into the thin paper substrata. The ideal remedy is to accept as useful for seed germination work trays made of only the best nontoxic materials among which are some new ones such as bakelite and plastic products just coming onto the market and which in preliminary tests were found to be entirely acceptable.

Summary

Germinator trays constructed of galvanized wire cloth, even when covered with a thin copper dip, yield varying amounts of zinc sufficient to very seriously affect if not entirely prevent germination of seeds placed thereon.

Determinations made for zinc with a plarograph showed as high as 8,837 micrograms of zinc as Zn in some blotting papers after being used as substrates and showing the typical white stains or streaks which caused toxicity to seedlings. Carrot seedlings killed by toxicity carried 0.733 percentage of Zn (dry basis). The condensation drip from the top of the galvanized iron germinators was highly toxic when it fell on the substrates. It was found to contain 1.21 per cent of zinc as Zn (dry basis). The white salt rubbed from the sides and tops of the galvanized iron germinators was found to consist of 72.55 per cent of Zn.

Experiments made with different strength solutions of zinc as anhydrous $ZnSO_4$ showed quite clearly that the threshold of toxicity to carrot seeds germinating on blotting paper was approximately 1,500 p.p.m. The threshold of toxicity for the different strength of zinc solution used, varied for blotting paper, absorbent cotton and filter paper depending at least in part upon their sorptive power.

The effect of zinc was not always toxic since in a series of experiments a solution containing 500 p.p.m. of $ZnSO_4$ used to moisten the regular blotting paper used for germination testing caused a noted beneficial effect upon lettuce seedlings. This was what might be expected in view of the recent findings as to the influence of certain minor elements upon plant production.

The ideal approach to a solution of the difficulty is to use materials other than galvanized iron for the construction of the germinator trays at least, since paints, dips, and lacquers used to cover up the free zinc were not entirely satisfactory and proved to be only temporary expedients.

Literature Cited

1. Chandler, W. H. Zinc as a nutrient for plants. Bot. Gaz. 98:625-646. 1937.
2. Crosier, W. F., Patrick, S. R., and Willits, C. O. Zinc injury in germination tests. Proc. Intern. Seed Testing Assn. 9: 257-262. 1937.

3. Crosier, W. F., and Patrick S. R. Injuries to seedlings induced by chemicals dissolving from germinator trays. Proc. Assoc. Off. Seed Anal. 1938. 253-254. 1939.
4. Lockwood, L. B. Rhizopus oryzae: Spore germination, early growth, and fermentation. Proc. 3rd Internatl. Cong. Microbiol. Page 229. 1939.
5. Reed, H. S. The relation of zinc to seed production. Jour. Agr. Res. 64, 11:.635-644. 1942.
6. Willits, C. O. and Tressler, C. J. Jr. The preparation and painting of maple-sugar-producing equipment. Jour. Agr. Res. 59: 151-158. 1939.

GERMINATION RESPONSE OF VERNALIZED TARAXACUM SEED[1]

M. T. Munn

New York State Agricultural Experiment Station, Geneva, N.Y.

Stocks of seed of the Russian dandelion (Taraxacum kok-saghyz) forwarded to this Station by the United States Department of Agriculture early in May of 1942 for experimental rubber production purposes were accompanied by definite instructions as to procedure to prepare the seed for planting, i.e., a slow and limited germination of the seed at certain controlled temperatures. The dry seed was accompanied by some seed in thermos jugs and said to be already vernalized. The instructions further pointed out that the main cause of poor yields of kok-saghyz was poor germination, that its germination differs from that of ordinary plants, that under ordinary conditions the seed enters a long rest period during which no seed germinates, and also, if tested on filter paper under laboratory conditions germinates quickly yet when planted in soil where the access of air is limited it completes its rest period after 20 to 30 days and thus plantings of dry seed direct to the field gave poor stands. It was further explained that the seed must be made "properly ready by treating it 2 or 3 days prior to planting," also, that the seed must be "stratified" for a period of 10 to 20 days, i,e., the seed is moistened and kept on ice or under snow. Specific directions were given for check testing the seed under preparation, for controlling the germinative response in case delay in planting was necessary, and for hastening the initial germination if the seed was tardy. The desired aim was to get carefully treated, germination-ready seed planted in moist soil to a depth of about one centimeter and thus get a simultaneous quick stand of plants.

The technique of vernalization as proposed in the instructions was essentially that by means of soaking or wetting, the seed is transferred from a state of rest into a state of active life yet the soaking is not continued until complete absorption of water, thus preventing growth from continuing at full speed. If the vernalized seed could not be planted it was to be spread out in a thin layer in a cool (0 to 5°C) room and thus slightly dried. It would seem that the term vernalization as used in connection with this rubber plant production study had only one of the meanings postulated by Lysenko[2], namely a practical method of accelerating plant development by hastening the further germinability of the seed into seedling establishment once it was placed in the soil under optimum conditions. At any rate one would be dealing not only with seed that was soaked, but also with seed that had begun to actually germinate.

1. Journal Paper No. 582, New York State Agricultural Experiment Station, Geneva, N. Y.
2. Lysenko, T. D. Fundamental results of researches on vernalization of agricultural plants. Bull. Jarovizacci. 4:1-57. Odessa, 1932.

So much emphasis was given to the necessity of "preparation," "treatment," or "vernalization" that tests were made with the seed stocks submitted for planting to observe how they responded to various test conditions both before and after vernalization. Rather than give tabulations the results in general, can for all practical purposes be briefly presented in condensed form:

Description of the seed used	Germination Av. %
Untreated seed, tested at 20-30°C alternation, in darkness	88
Vernalized seed, " " " "	58
Vernalized " , then dried and wet again, " "	64
Untreated seed, kept in moist peat moss at 5°C	93

The Results Summarized

The best and most consistent germination of Russian dandelion seed was secured with the untreated seed when germinated at an alternating temperature of 20 to 30°C in darkness. In most cases it completed its germination in 14 days and was often finished in 7 to 10 days.

When untreated seed was germinated in daylight and at 20°C the results were usually about one-third as high as at 20 to 30°C in darkness. The exceptions were encountered when vernalized seed from a low temperature was brought into more moist conditions in a germinator when it often showed a complete response at the lower temperature though not so rapidly as at the higher temperature.

Vernalized or started seed seemingly became more physiologically sensitive to germinative surroundings and one could not predict its probable response when transferred to other conditions. Also, vernalized seed when dried sufficiently to facilitate sowing is especially sensitive to conditions and if the soil is not optimum as to moisture content it may revert to secondary dormancy from which it can be recovered only with difficulty in the laboratory. Vernalized seed also tended to become overgrown with fungus growth to an objectionable and harmful extent unless one is very careful and is able to control conditions.

When planted in the field by far the best uniform stands resulted from the use of the untreated seed. The plot planted with vernalized seed was abandoned due to a poor stand which may have been due to weather or soil conditions not quite suited to the vernalized seed or else it was more sensitive and did not respond as expected.

As to seed characteristics it was found that seed harvested from mature plants at the period or stage when it was ready to blow or fall, germinated very readily. Germination percentages of various stocks ranged from as low as 10% to as high as 95%, - much depended upon maturity and plumpness of the seed. The number of seeds per pound varied from 1,006,992 to as high as 1,360,800 per pound. The best lots of seed weighed 18 pounds per stricken bushel.

Observations on Parthenogenesis and Seed Production

In connection with the production and harvesting of the seed of this rubber bearing species of Taraxacum the question of pollination was investigated. Following out the technique previously described and used by the writer[1] in investigating parthenogenesis with the dandelion, buds on

1. Munn, M. T. Spraying lawns with iron sulfate to eradicate dandelions. N. Y. State Agrl. Expt. Sta. Bul. 466:25-27, 1919.

plants were castrated and then bagged. When later tested for germination along with seeds from treated buds and from untreated seedheads a germination of three per cent of the seeds was secured in a relatively few days. While the results were not entirely conclusive or satisfactory from the limited material it was concluded that evidently parthenogenesis or apogamous development of the embryo occurs in Taraxacum kok-saghyz.

COMPARATIVE LABORATORY AND FIELD GERMINATION OF ONION SEED[1]

Ben E. Clark

New York State Agricultural Experiment Station, Geneva, N.Y.

Each year New York onion growers submit to the seed testing laboratory a considerable number of onion seed samples for germination test for guidance in planting. When germinated, many of these samples show a relatively high percentage of abnormal germinants of various types and some of low vitality. This was particularly true this past season when many lots of home-grown seed were saved and commercial stocks were not very abundant. In each case it is always a quandary to know just how to appraise these abnormal germinants in terms of possible usefulness in the field. For this reason an experiment was undertaken to determine the relationship between the laboratory germination percentages found and the actual stand of onion plants in the field.

Review of Literature

Cole (2)[2] found many samples of onion seed with abnormalities and concluded, after testing them in the laboratory and in greenhouse flats, that only those sprouts which present healthy root tips with the tuft of root hairs should be counted in preliminary counts and that all seeds not producing a healthy root tip with root hairs or which produced constricted or otherwise abnormal sprouts should not be considered in the final count as having germinated. She was of the opinion that all of the abnormal sprouts and some of the less vigorous normal seedlings would fail to develop into mature plants in the field.

A number of workers, Brown and Toole (1), Erickson and Porter (3), Goss (4), Hay (5), Munn (6) (7), Porter and Rice (8), Shuck (9), Stevens (10), Stahl (11) (12), Sylvester (13), and Whitcomb (14) (15) (16), have made greenhouse and field tests to determine the correlation between laboratory germination tests and field stand performance of various kinds of seed. In general, these experiments have indicated that field germinations may be expected to be lower than laboratory germinations but that ordinarily those samples which germinate highest in the laboratory also germinate highest in the field.

Stahl (12) found that in the case of cabbage and cauliflower, there was a closer correlation when stocks of high vitality were tested than when stocks of low vitality were tested.

Whitcomb (16) classified oat seedlings and transferred them from the germinator to field soil. He found that seeds which produced normal plumules in a six day laboratory test, even though the radicles were abnormal, produced a satisfactory percentage of plants in the field and that seeds which produced only very weak plumules and no radicles and

1. Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 574.
2. Refers to literature cited.

also seeds which appeared to be dead in the laboratory test produced some plants in the field.

Materials and Methods

The seed samples used in this experiment were received for germination testing from farmers and dealers between December, 1941 and April, 1942. The laboratory germination tests were made as soon as the samples were received after which the samples were stored in the laboratory at room temperature until planting time. The laboratory germination tests were made on top of blotters at 20°C in the dark for 10 days. No preliminary readings were made. At the end of 10 days, the seedlings were counted and classified as normal, doubtful, or abnormal.

At planting time, 400 seeds were counted from each sample, 200 of which were treated with 1205FF, a chemical disinfectant.

The seeds were planted about one-half inch deep in a fairly heavy loam soil. The 400 seeds were planted in a 12 foot row, the 200 untreated seeds were planted in the west half of the row and the 200 treated seeds were planted in the east half. The plantings were made on May 1st. The field was irrigated as often as necessary to prevent crusting of the soil surface but care was taken to avoid excessive wetting. Field germination counts were made 25 days after planting at which time the plants had become well established.

Field vs. Laboratory Germination

In most cases the chemical seed treatment used in this experiment had little effect on field emergence. The average increase from treatment was less than 5%. An increase of 15 to 20% was obtained in the case of several of the weaker and more heavily fungus-infested samples, but on the whole the effect of the treatment was not considered significant. The field germination referred to below is the average germination of the treated and untreated seeds.

Table 1 and Figure 1 show the relationship between laboratory

TABLE 1. - Relationship between Laboratory and Field Germination of Groups of Samples Classified According to Their Laboratory Germination Percentage.

Range in laboratory germination	Number of samples	Laboratory germ. average	Field germ. average	Difference	Average number plants per 100 seedlings
%		%	%	%	
0-9	10	4.4	3.0	1.4	68
10-19	5	13.2	4.8	8.4	37
20-29	6	25.2	17.8	7.4	72
30-39	16	34.3	23.4	10.9	68
40-49	23	44.1	32.0	12.1	72
50-59	16	54.7	36.3	18.4	66
60-69	28	64.9	40.4	24.5	62
70-79	28	74.3	47.0	27.3	63
80-89	24	84.2	57.8	26.4	68
90-100	3	95.0	55.0	40.0	59
0-100	159	56.0	36.8	19.2	65.7

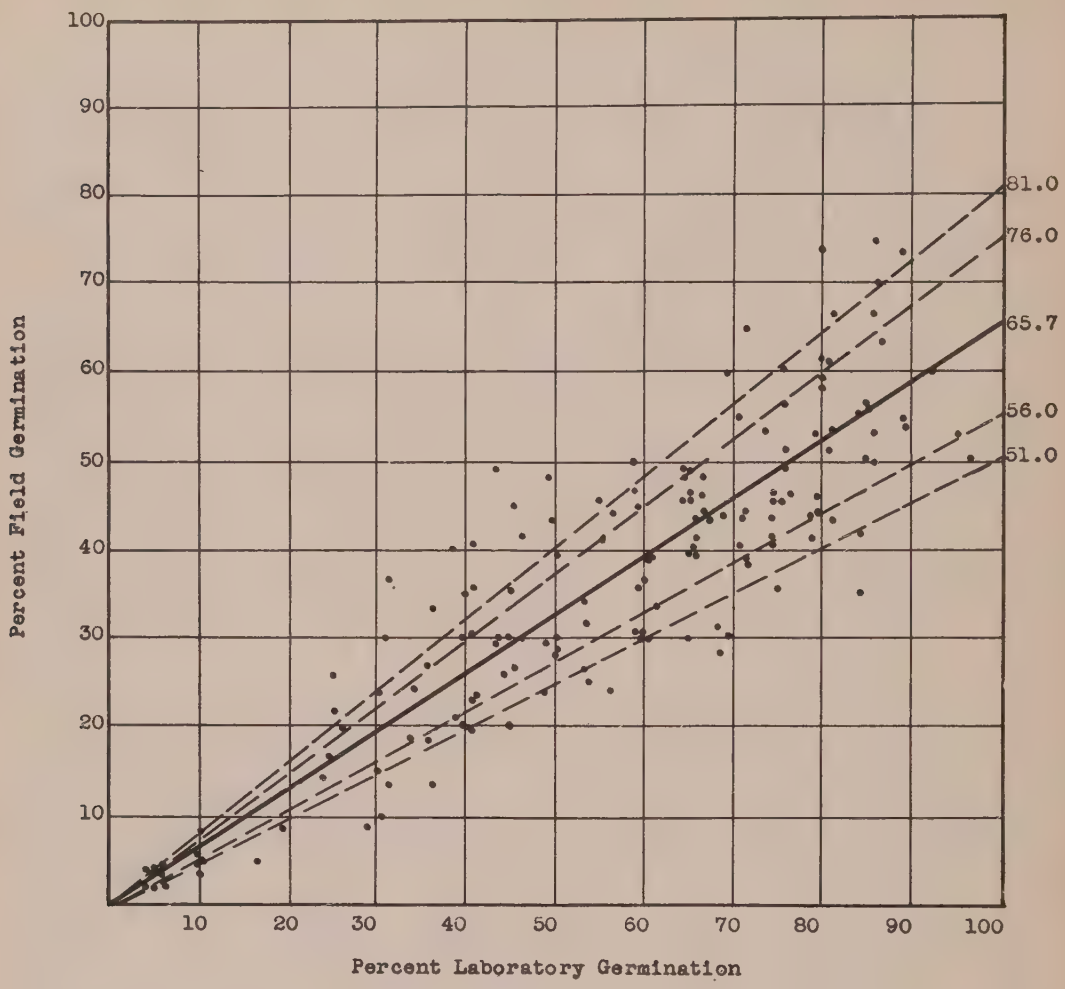


Fig. 1 - Relationship Between Laboratory and Field Germination of Individual Samples of Onion Seed.

It will be seen from Table 1 and Figure 1 that the field germination was lower than the laboratory germination and that the difference between the two was greater for the samples with the higher germination and less for the samples with the lower germinations. However, the number of plants produced in the field per 100 normal seedlings in the laboratory is fairly constant throughout the germination range with the exception of the samples which had a laboratory germination of 10 to 19%. There were only 5 samples in this range and it is thought that there were too few samples to establish a true value.

At first thought it does not seem logical that there should be a greater difference between laboratory and field germinations for high germinating stocks than for low germinating stocks, but as the data are scrutinized more carefully it becomes apparent that the ratio of field germination to laboratory germination is fairly constant throughout the range of germinations tested. The average ratio for all samples tested was

65.7 plants in the field to 100 normal seedlings in the laboratory. For the group 30 to 39%, the ratio was 68:100. The same is true for the group 80 to 89%. The other groups except 10 to 19% fall in line rather closely. This is what would be expected if the same definite mental, pictorial or visual standard were used in interpreting the germination of all stocks whether of high vitality or of low vitality.

Since the ratio of field to laboratory germination is constant throughout the range of germinations tested, it may be used as a standard in determining the validity of laboratory germination test findings or readings. Samples which in the field produced considerably less than or considerably more than 65.7 plants per 100 normal as determined in the laboratory may be considered to have had their field value misinterpreted. It must be remembered, however, that greater variation is to be expected in the field than in the laboratory because of the impossibility of maintaining as uniform conditions in the field as are possible in the laboratory.

Figure 1 shows the relationship between field and laboratory germination for the individual samples. It can be seen from this graph that, in general, as has been shown before, the samples which had the higher laboratory germinations also produced the greater number of plants in the field. The solid line in the center of the graph indicates the average number of plants (65.7) per 100 seedlings. The other lines indicate respectively 51, 56, 76 and 81 plants per 100 seedlings. The dots falling between these lines represent samples having intermediate values. In the field, 118 samples, or 74.2% of all the samples tested, produced between 51 and 81 plants per 100 normal seedlings as found in the laboratory. This is a variation of less than 15% from the average (65.7 plants per 100 seedlings). Furthermore, 93 samples, or 58.5% of all the samples produced between 56 and 76 plants per 100 seedlings, a variation of less than 10% from the average.

It is apparent from the graph, that the greatest variation between field and laboratory germination occurred in samples having a laboratory germination between 30% and 60%. Of the 55 samples having a laboratory germination between 30% and 60%, 22, or 40% of them had a field germination that varied more than 15% from the average. Of the 21 samples below 30%, 7, or 33.3% varied more than 15% and of the 83 samples above 60, only 13, or 15.7% varied more than 15%.

The laboratory record of doubtful and abnormal germinants shows that there was an average of 23.9% doubtful and abnormal germinants for the samples having a laboratory germination between 30% and 60%. For those having a laboratory germination between 0% and 30%, the average number of abnormal and doubtful germinants was 17.6%, and for those above 60, it was 11.4%. It is evident that variation between field and laboratory germination was proportional to the number of doubtful and abnormal germinants in the sample. This indicated that the evaluation of doubtful germinants was not always entirely correct in the laboratory.

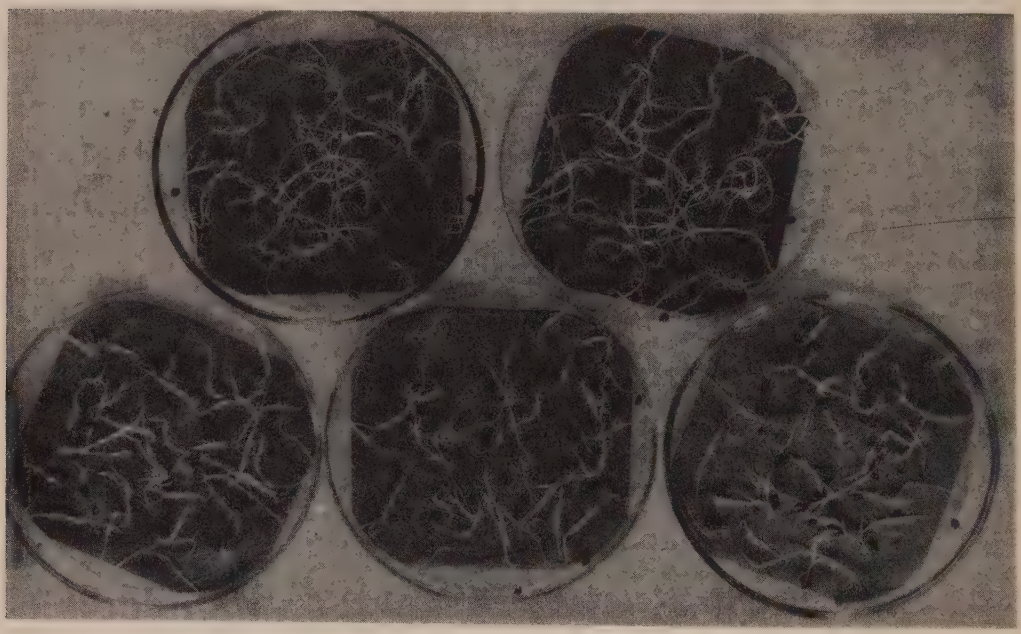
Evaluation of Abnormal Germinants or Sprouts

The problem then was to devise a method of testing the field value of abnormal germinants. Cole (2) considered that sprouts without healthy root tips and root hairs, as well as those with a constricted or otherwise abnormal cotyledon should not be counted in laboratory germination tests. However, Drake (17) found samples of onion seed which produced sprouts without root hairs but which were apparently normal in other respects.

It had been observed at this laboratory that some types of seedlings failed to produce root hairs when germinated under very moist conditions. In order to determine whether or not onion seedlings are affected in this way, onion seeds were germinated with varying amounts of moisture. In this experiment 12 cc of water were poured into each of 5 petri dishes. Then, using uniform discs, 1 piece of blotting paper was placed in the 1st dish, 2 in the 2nd, 3 in the 3rd, 4 in the 4th, and 5 in the 5th. The first petri dish contained considerable free water so that the seeds were almost floating. The second petri dish was very moist but there was little free water. The third petri dish contained what was considered an optimum amount of water and the 4th and 5th petri dishes were considered to be too dry for best germination.

Figure 2 shows the results of this experiment. It will be observed

1 2



3 4 5

Fig. 2. - Showing the relative amount of root hairs formed on onion seedlings germinated under varying amounts of moisture in the substratum. Dish No. 1; abundant moisture present, seeds nearly floating. No. 2; fairly moist, but no free water, - no root hair development under two preceding conditions. No. 3; about optimum moisture condition. Note good root hair growth, also that fungus growth quite common to onion seed, began to develop at this point. No. 4; not quite enough moisture, yet good germination and root hair formation. No. 5; substratum seemingly too dry, yet good germination and abundant root hairs.

that there are very few root hairs on the seedlings germinated under the very moist conditions, whereas, there is a heavy growth of root hairs on the seedlings germinated under the drier conditions. It is apparent that the formation of root hairs can be affected by environmental conditions as well as by heredity and by condition of the seed stock.

In another experiment an attempt was made to determine the value or further development of certain types of onion seedlings by transferring them to muck soil after they had been germinated on blotters. After seven days germination the seedlings were very carefully taken from the blotters, arranged in order according to their vigor, photographed and then transferred to a flat of muck soil in a daylight germinator. Figure 3 shows the arrangement or range of specimens used. Most of the sprouts continued to grow to a more or less degree yet many of them failed to produce an adequate root system. It was thought that the sprouts with inadequate roots

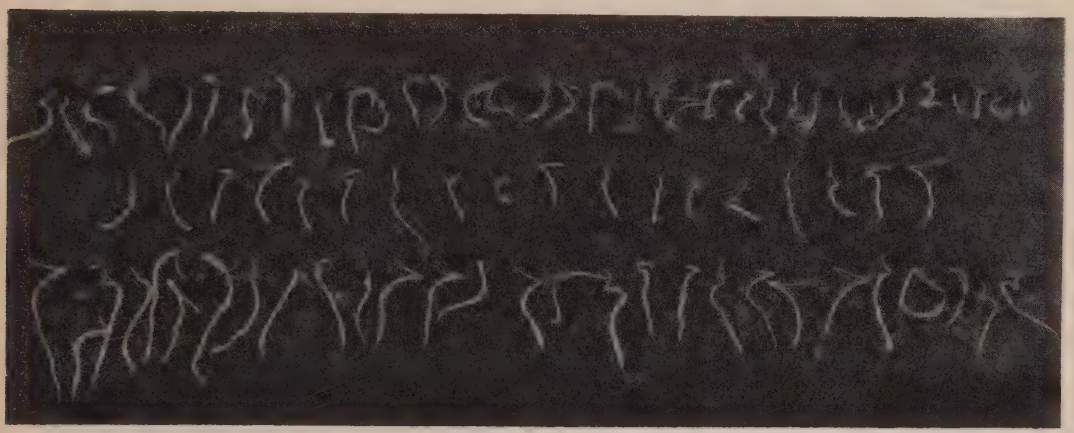


Figure 3. - Onion germinants arranged in order of their visible vigor; from the most vigorous in the lower left-hand corner to the weakest in the upper-right hand corner in the two long rows. The center row shows a group with blunt root tips nearly all of which failed to develop further in the favorable soil conditions in the greenhouse flats. Most of the seedlings continued to grow but nearly all of those in the upper row failed to develop an adequate root system.

would not have been able to survive in the dryer atmosphere of the open fields. In order to test this, onion seeds were germinated on blotters and after seven days the germinants were classified as to vigor and abnormalities, photographed, and transferred directly to soil in the field. The soil was sprinkled as often as necessary to keep it from becoming too dry.

Figure 4 shows the seedlings before they were placed in the field.

Figure 5 shows the seedlings after having been grown in the field for 16 days and indicates the relative response of the various groups. It might be found in normal field agricultural practice that these results with some of the definitely abnormal groups may not faithfully represent the actual final crop results.

Conclusions

1. It is concluded from the above experiment that, except under perfect field conditions, the field germination of any lot of onion seed will

1 2

3 4 5

Figure 4. - The onion seedlings as classified and ready to be transferred to soil in the field. Dish No. 1; apparently strong and normal seedlings. No. 2; those with definite weakness in the stem limb or stem side of the cotyledon. No. 3; those with weak or no definite stem - or seed-side to the cotyledon. No. 4; those with abnormal knees. No. 5; those apparently normal yet weak and slow to germinate.

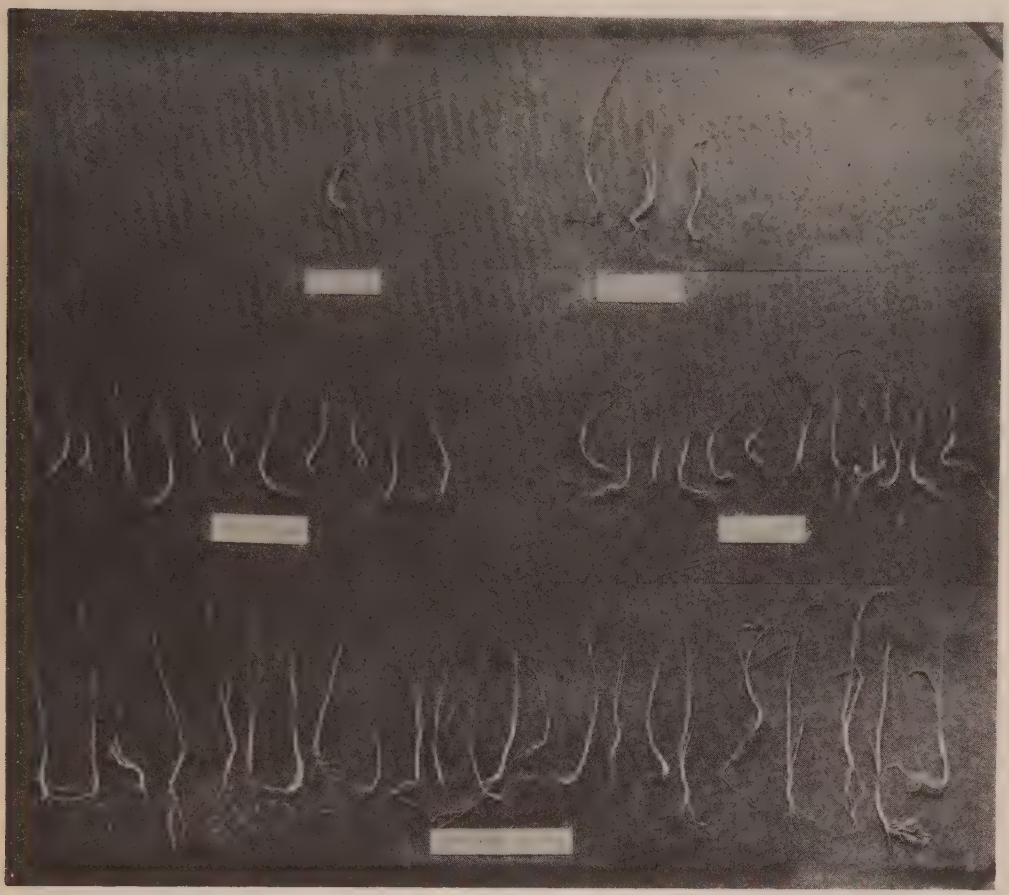
not be as high as the laboratory germination but that it should be proportional to it. In this experiment the average ratio for all samples tested was 65.7 plants in the field to 100 apparently normal seedlings observed in the laboratory.

2. If the laboratory germination responses are interpreted correctly, i.e., on the basis of a visibly normal seedling, samples with a low reported laboratory germination percentage will produce as high a proportion of plants in the field as those with a high laboratory germination percentage.

3. Provided enough samples are tested and field conditions are sufficiently uniform, field tests may be used to check the validity of the laboratory germination interpretation of individual samples of onion seed. The number of plants produced in the field per 100 normal seedlings observed in the laboratory seems to be a more satisfactory index of field value than the actual field germination test. Samples producing far more than or far fewer than the average number of plants per 100 normal seedlings may be considered to have been either read incorrectly in the laboratory or subjected to some exceptional condition in the field.

4. Since root hair formation is affected by moisture relationships and apparently varies with stocks, it cannot be used as the only criterion in distinguishing between normal and abnormal seedlings.

3 2



1

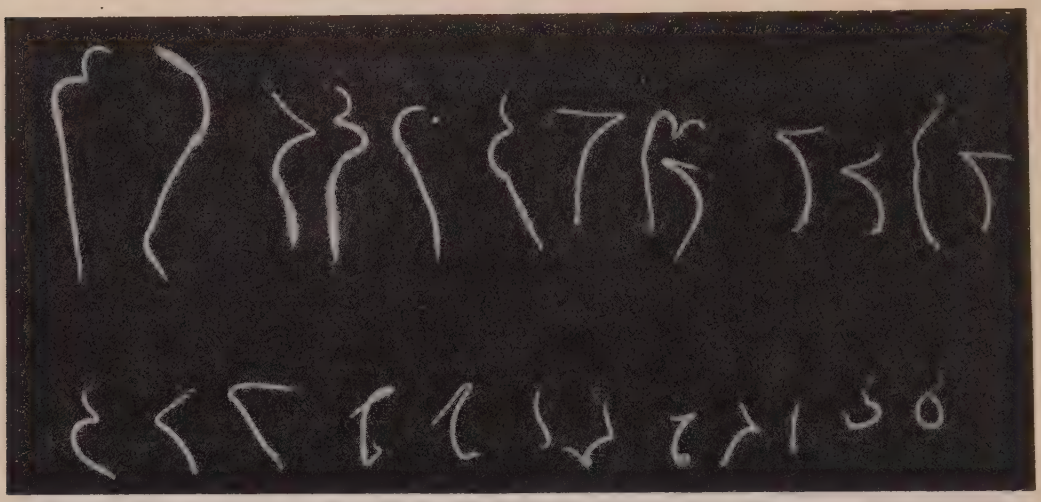
Fig. 5. - The onion seedlings shown in Figure 4 after having been growing in the field for 16 days.

1. - Strong normal seedlings (See Dish No. 1, Fig. 4) produced 95% strong plants.
2. - Those with a weak stem-limb (Dish No. 2, Fig. 4) produced 10% of plants.
3. - Those with weak or no stem- or seed-limb side to the cotyledon (Dish No. 3, Fig. 4) produced 8% of plants.
4. - Those with abnormal knees (Dish No. 4, Fig. 4) produced 50% of plants.
5. - Those apparently normal yet seemingly slow and weak germination (Dish No. 5, Fig. 4) produced 50% of plants.

5. - According to these experiments one may expect to get normal onion plants in the field at about the indicated frequency from the following types of seedlings.(See also Fig. 6).

a. Practically all strong normal seedlings, that is, those with normal radicles, knees, and stem- and seed-sides to the cotyledon.
b. About half the seedlings with abnormal knees.
c. About half the seedlings which are weak and slow but otherwise normal.
d. Very few of the seedlings with weak radicles.
e. Very few of the seedlings with no radicles.

A B C D E F G H I J K L M



N O P Q R S T U V W X Y

Figure 6. - Some prevalent types of onion seedlings commonly observed in onion seed germination testing. All of these types were involved in this experiment.
Seedlings A to F unquestionably safely counted as fully germinated and of field value.
Seedlings of the G and H types of very questionable value.
Seedling type I probably has value because of equal sided knee.
Seedlings types J to Y, that is those with abnormal or no knees, and those with a blunt, constricted, glassy, discolored, nondeveloping hypocotyl end (sometimes spoken of as having no radicle) are safely considered worthless in agricultural practice, - of no field value.

Literature Cited

1. Brown, E. and Toole, E. H. Evaluation of seedlings. Proc. Internat. Seed Test. Assoc. 11. 2:89-95. 1939.

2. Cole, Grace M. A discussion of an abnormal sprout occurring in onion seed germination. Proc. Assoc. Off. Seed Anal. N. Amer. 1925:56-61. 1926.

3. Erickson, E. L. and Porter, R. H. Laboratory tests of field crop seeds as an index of seedling value. Iowa Agr. Expt. Sta. Res. Bul 239. 1938.

4. Goss, W. L. Greenhouse and germinating-chamber tests of crimson clover seed compared. Proc. Assoc. Off. Seed Anal. N. Amer. 1919-64. 1919.

5. Hay, W. D. Laboratory and field germination of infected beans: Effectiveness of seed transmission. Proc. Assoc. Off. Seed Anal. 1930: 80-82. 1938.

6. Munn, M. T. Comparing laboratory and field viability of seed of garden peas. Proc. Assoc. Off. Seed Anal. N. Amer. 1925-55. 1926.

7. Munn, M. T. Comparison of field and laboratory tests. Proc. Assoc. Off. Seed Anal. N. Amer. 1930:87. 1938.

8. Porter, R. H. and Rice, W. N. Laboratory and field germination of treated and untreated beet seed. Proc. Assoc. Off. Seed Anal. N. Amer. 1939: 127-129. 1940.

9. Shuck, A. L. The germination of lettuce seed in the laboratory and in the field. Proc. Assoc. Off. Seed Anal. N. Amer. 1936: 80-83. 1936.

10. Stevens, O. A. Germination studies on aged and injured seeds. Jour. Agr. Res. 51: 1093-1106. 1935

11. Stahl, C. Comparative experiments between the laboratory and field germination of seeds. Proc. Inter. Seed Test. Assoc. 2. 15-17: 75-143. 1931.

12. Stahl, C. Laboratory and field germination of cabbage seed. Proc. Inter. Seed Test. Assoc. 5 1:42-56. 1933.

13. Sylvester, E. P. Farm demonstrations as a measure of seed viability in alfalfa, red clover, and sweet clover. Proc. Off. Seed. Anal. N. Amer. 1938: 172-173. 1939.

14. Whitcomb, W. O. Correlating laboratory tests with field tests. Proc. Assn. Off. Seed Anal. N. Amer. 1920: 51 54. 1921.

15. Whitcomb, W. O. Correlation between laboratory and field tests. Proc. Assoc. Off. Seed Anal. N. Amer. 1923: 60-62. 1924.

16. Whitcomb, W. O. Interpretation of germination results: Transfer of germinated seeds from blotters to field soil. Proc. Assoc. Off. Seed Anal. 1935: 73-77. 1936.

17. Drake, Vera A. Germination of onion sprouts with no root hairs. News Letter. Assoc. Off. Seed Anal. 16: 1:5. 1942.

ONION SEEDLINGS DEVOID OF ROOT HAIRS

G. E. Nutile
Seed Testing Laboratory
Associated Seed Growers, Inc., New Haven, Conn.

When germinating onion seed the question arises as to whether or not onion seedlings as seen upon artificial substratum and which appear normal in every other respect yet lack root hairs are capable of continued development in soil under favorable conditions and thus meet the requirements of the definition of germination as laid down in the American Rules for Seed Testing. In the International Rules for Seed Testing[1] it is stipulated that seedlings of onion are considered abnormal if they show blunt or constricted root tips or are without a tuft of root hairs. Cole[2], as a result of her work, stated that a normal onion sprout should have a tuft of root hairs yet her article deals mainly with the abnormal onion seedling which entirely lacks a primary root or has a constricted radicle at the joint of the hypocotyl and root.

In our laboratory it was observed that many samples of onion seed when tested between blotters produced a rather high percentage of seedlings with no root hairs. The samples tested were from crops harvested from 1937 to 1941 inclusive and the seeds which produced seedlings with no root hairs were not restricted to 1941 crops. Many samples germinated below the 70% minimum when seedlings which lacked root hairs were considered abnormal. Of

1. International Rules for Seed Testing. Proc. Internatl. Seed Test Assn. 10. 1:420. 1938.
2. Cole, Grace M. A. discussion of an abnormal sprout occurring in onion seed germination. Proc. Assoc. Off. Seed Anal. N. Amer. 1925: 56-61. 1926.

more than 100 samples tested, the percentage of seedlings which were normal in every respect but lacked root hairs, ranged from 5 to 50% for the various samples. The majority of samples tested had between 15 and 30% of their germinants devoid of root hairs. This type of seedling appearing without root hairs does not appear to be due to a varietal difference since it was observed on several different varieties. The amount and vigor of the root hairs and their place of development on the radicle varied with the individual cases. On some the root hairs extended from one-eighth to more than one-half inches along the radicle. On others, the root hair development amounted to a slight tuft at the joint of the hypocotyl and radicle whereas a few produced them just back of the growing point or midway on the radicle. Then again the root hairs on some were so slight that a hand lens was necessary to detect their presence. It was also noted that some seedlings which lacked root hairs, after being in test for five days, developed root hairs on some portion of the radicle or produced secondary roots on which root hairs sometimes developed if left in test for a longer period of time. However, there were many seedlings which never produced root hairs when left in test for as long as eighteen days.

The Further Development in Soil of Seedlings Devoid of Root Hairs

Seven onion samples which produced varying percentages of seedlings with no root hairs were sent to each of nine seed testing laboratories to determine if any of these laboratories considered seedlings with no root hairs as abnormal. From the data presented in Table 1, it appears that none

Table 1. - Germination Test Results of Onions Reported from Various Laboratories

Lab. No.	Variety and Lot Number						
	Ebenezer				Crystal Wax		Brigham Yellow Globe
	46540	46535	46544	46536	2-950	2-963	46523
	%	%	%	%	%	%	%
1	95.00	98.00	92.00	97.00	86.00	90.00	94.00
2	93.75	92.50	93.50	86.25	84.00	90.00	93.50
3	95.00	95.00	94.00	97.00	87.50	98.00	97.00
4	97.00	99.00	95.00	98.00	86.00	96.00	94.00
5	97.00	95.00	95.50	95.50	80.00	91.00	94.50
6	95.50	96.50	95.50	97.50	84.50	91.50	96.00
7	94.00	93.62	92.25	95.87	85.25	93.12	94.50
8	92.50	94.50	90.00	96.50	78.50	91.25	94.50
9	95.37	96.25	93.75	95.87	79.50	92.00	93.12
10	95.25	90.25	93.00	95.00	81.00	90.75	92.50
Percentage of seedlings with no root hairs*	30	23	8	6	56	14	20

*In this line are shown the respective percentages of seedlings devoid of root hairs as determined in our laboratory for each of the samples.

of these laboratories considered such seedlings as abnormal or else no attention was given to root hair development. The percentage of seedlings which lacked root hairs in each sample was determined at this laboratory and is also given in Table 1. These same seven samples were also tested by the writer in blotters and planted in the greenhouse in sterilized soil. After seven weeks, the percentage of plants, which had become established in soil, was found to be comparable to the germination percentages obtained in the blotter test. The data is given in Table 2 and is evidence that the seedlings which lacked root hairs in the blotter tests are capable of continued growth in soil or that these seedlings produced root hairs when the seed is sown in soil.

TABLE 2. - Germination percentage obtained in soil and blotters on onion lots listed in Table 1.

Variety and Lot no.	Substrata	
	Blotter. Duration of test 14 days	Soil Counts made after 4 weeks
Ebenezer	%	%
46540	97.00	93.50
46535	90.00	93.00
46544	95.50	92.50
46536	95.00	93.50
Crystal Wax		
2-950	81.50	80.50
2-963	90.00	87.50
Brigham Yellow Globe - 46523	93.50	91.50

Another experiment was conducted to determine whether or not the actual seedlings with no root hairs as found in the blotter test were capable of becoming established in soil and to observe their rate of growth as compared with those with root hairs. Fifty seedlings with root hairs and fifty with no root hairs were transplanted from blotters into sterilized soil in eight-inch pots. Twenty-five seedlings were planted in each of four pots. They were grown in the greenhouse for seven weeks and were then uprooted and photographed. There appeared to be no significant difference in the rate of establishment or growth between the transplants with root hairs and those with no root hairs. (Fig. 1) Also as shown in Fig. 2, there appeared to be no striking difference in the root systems. It was impossible to observe root hairs on the pulled seedlings as they were very likely rubbed off when the seedlings were uprooted.

In another experiment, it was found that seedlings which lacked root hairs in the blotter test produced these when transplanted and grown in soil. A number of seedlings of the variety, Ebenezer, with no root hairs observed in test were transplanted to soil in 600 cc beakers. The seedlings were planted against the inside surface of the glass so that early root development could be easily observed. The beakers were wrapped with black paper to shield the roots from light. Every third day the beakers were uncovered and the roots examined. After six days some of the primary roots developed a tuft of root hairs just back of the growing point. It was also observed that some seedlings had not developed root hairs on their primary

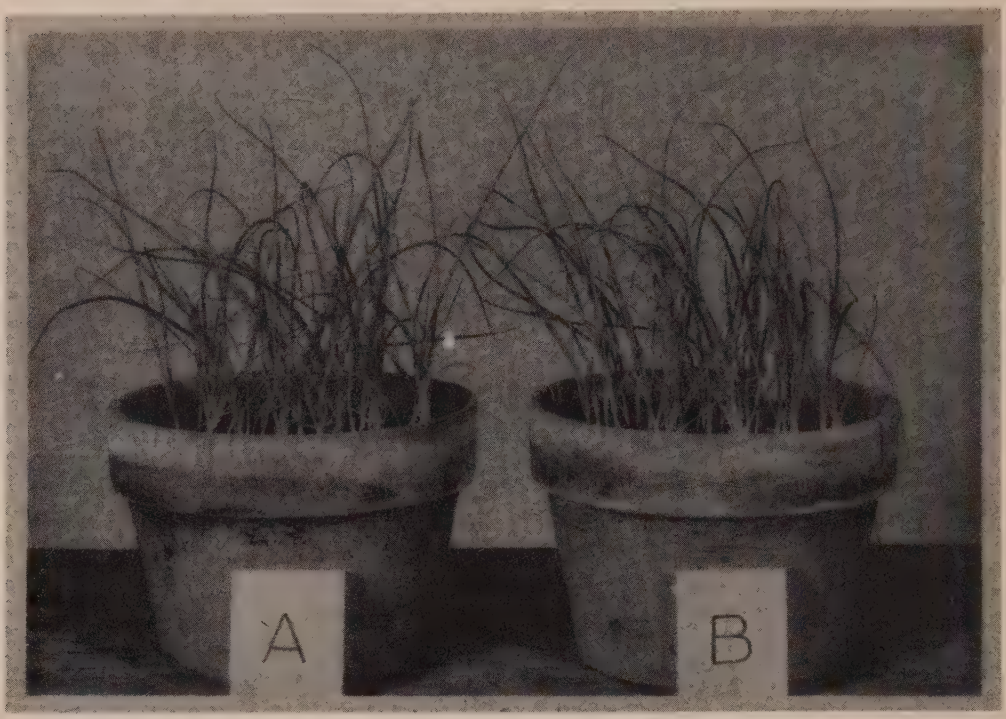


Fig. 1. - Plants from seedlings transplanted from blotter tests to soil. A. - Seedlings with root hairs. B. - Seedlings without root hairs.

roots after nine days. After this period of time, the growing point of the primary roots in most cases could not be observed as they either grew into the soil or could not be distinguished from the roots of other seedlings. All seedlings, however, produced an abundance of secondary roots on which root hairs developed.

The writer has not come to any definite conclusion as to why some onion seeds produced seedlings with no root hairs. Further work will be conducted in search of any possible explanation.

Conclusions

1. Onion seedlings which lack root hairs in the blotter test but are normal in every other respect are capable of continued growth in soil and therefore should not be considered abnormal.

2. This type of seedling with no root hairs should not be confused with the abnormal germinant which entirely lacks a primary root or has a blunt or constricted radicle at the joint of the hypocotyl and root.

Figure 2. - Root systems of seedlings shown in Figure 2.
A. - With root hairs. B. - Without root hairs.

MATERIALS AND METHODS IN CONTROLLING SEED-CONTAMINATING MICROORGANISMS[1]

Willard Crosier

New York State Agricultural Experiment Station, Geneva, N. Y.

The subject of chemical control of laboratory molds has been discussed on previous occasions before this association. It has been stated that several advantages accrue from the practice of seed treatment or disinfestation. Principal among these are; elimination of troublesome molds and bacteria, prevention of seed and sprout rot, usually an apparent increase in germination, increased ease of andaccuracy in determining strength of germinants, increased speed in reading tests, and greater ease in observing and identifying seed-borne pathogenes.

Seed treatment in the laboratory is a natural outgrowth of seed treatment designed to prevent introduction of disease organisms into the field or to inhibit the aggressiveness of damping-off fungi already present in the soil. Whether in the laboratory or in the field, treatment is practiced to allow viable seeds to develop into normal plants. Chemicals applied to seeds do not increase the percentage of germination. Although chemical treatment usually does result in emergence or normal germinant increments. These increments are possible simply because certain microorganisms could not interfere with the growth of the sprouts. It is an established fact that both fungi and bacteria attack strong as well as weak sprouts although the period of susceptibility to damping-off fungi is limited to a short juvenile stage of growth. Actually strong, high germinating stocks of seeds may be benefited more than low germinating stocks because crowding in a laboratory test, or in a greenhouse flat or in the field facilitates the spread of microorganisms.

Chemical treatment of seeds prior to germination in the laboratory infrequently has been criticized because the percentages of treated seeds producing normal germinants may exceed the percentages of emergence in the field. It is reasoned, therefore, that contaminating molds and bacteria should be allowed to destroy a few seeds or sprouts in the laboratory so that this apparent germination would coincide closely with field emergence. This reasoning presupposes that two errors will be compensative rather than additive. Since emergence of seedlings in the field is dependent upon the soil microflora and microfauna, the physical type of soil, preparation of seedbed, moisture and temperature as well as upon the seed itself it is impossible to determine the "stand" on the basis of laboratory germination alone. Any practice which prevents the interplay and vicissitudes of these environment factors reduces the gap between field stand and laboratory germination. Chemical seed treatment is the one practice which most successfully accomplishes this reduction.

New organic compounds are constantly being synthesized in chemical laboratories, the therapeutic value of well-known materials is being demonstrated and improved manufacturing methods are increasing the unit value of our common seed protectants. The present necessity of conserving our supplies of heavy metals such as copper, cobalt, magnesium, manganese, mercury and zinc has curtailed the production of certain agricultural chemicals. One prominent manufacturer has developed an excellent seed protectant containing magnesium but must now delay its introduction to the public. Another chemical company developed an organic mercurial to control grain smuts but

1. Journal Paper No. 579 of the New York State Agricultural Experiment Station, Geneva, N. Y.

now faces the shortage of mercury. Pure organics which contain no heavy metals are now available. They will become increasingly popular and will reach our laboratories on many kinds of seeds.

Tetrachlorobenzoquinone commonly known as chloranil and now sold as "Spergon" has been studied extensively throughout the United States and Canada. It is an excellent protectant against damping-off but is a poorer fungicide than the ethyl group of mercurials known as Ceresan, New Improved Ceresan and Semesan, Jr. Since Spergon adheres well to any type of seed it has been easily adapted to laboratory use. It is non-poisonous and is not disagreeable to the worker. In practice Spergon should be mixed with a diluent such as clay, celite, talc gypsum, walnut shell flour or wheat flour in various proportions. If one mixture does not control the seed borne contaminants a stronger one may be substituted.

Another proprietary organic compound sold as Spergonex has not proved successful in the laboratory. Treated stocks of corn, sweet-corn, barley, oats, field beans and vegetable soybeans have been injured during storage. It is difficult to evaluate this type of treated seed in the laboratory since injury and natural weakness may be confused.

More recently the makers of Spergon have released other compounds for experiments by phytopathologists. U.S.R. #601, an organic formaldehyde, has been studied at Geneva recently. Formaldehyde is slowing involved in the presence of moisture. The undiluted dust adheres heavily to most seeds and most kinds of seeds are injured when treated by the excess dust method. Muskmelon seeds treated with an excess of U.S.R. #601 may require as a long as 30 days to complete germination but all normally viable seeds will eventually produce germinants. The delay in emergence from soil is not markedly retarded by heavy dosages of this chemical. A mixture of 1 part of #601 and 3 parts of talc by weight satisfactorily controls molds on cucurbit seeds with no phytotoxicity. Seeds of corn or of lima beans will tolerate a mixture of 4 parts of #601 and 3 parts of talc. Molds were not completely controlled. A material marked U.S.R. #604 was similar to #601 in its phytotoxic action on cucurbit seeds. The undiluted dust controlled molds on sweet corn seeds and cause a very slight retardation in germination. Peas were definitely injured although molds were satisfactorily eliminated.

Through cooperation with Dr. W. F. Bruce of Cornell University tetrabromobenzoquinone or bromanil was synthesized experimentally. Being the next higher analog to chloranil in the halogen series this chemical was thought to be definitely fungicidal. Limited study on melon seeds, however, show slight control of molds and no seedling injury. The dust adheres heavily so its failure as a fungicide is due to its insolubility in water.

Tetramethylthiuramdisulfide, duBay #1205FF or "Thiosan" has proven to be a protectant comparable to Semesan and Spergon. Thiosan is slightly volatile but nearly insoluble in water. Experiments in our laboratory prove that it is not comparable to Ceresan, New Improved Ceresan or Semesan as a fungicide. Molds are controlled to about the same degree with Thiosan as with Spergon or U.S.R. #601. The undiluted dust may be applied to all types of seeds. Dips are not practical since the material does not go into solution and concentrations of 1.00 to 2.00% are required to effect control of microorganisms. Spergon and Thiosan[2] are now released for sale and will increase in popularity. They should be used and recommended for any purpose for which they are effective. The studies at this and other experiment stations have proven that both Spergon and Thiosan are excellent protectants

2. Recently the Bayer Semesan Co. has released "Arasan," a new dusting material nearly identical to Thiosan but superior for use in the laboratory.

against soil-borne organisms attacking seedlings of peas, sweet corn and other vegetables. It is reasonable to expect that seeds treated with these materials will appear in our laboratories.

Several recently synthesized dusts that contain a mercury compound as the active ingredient have been tried as fungicides against germinator molds. DuBay 1228E, a mercurial effective against grain smuts, reduced molds on beans, corn and peas to a readable point in comparison to control tests too overrun with contaminants to be evaluated.

Dilutions of ethyl mercury tartrate were valuable as laboratory fungicides. This mercurial is both volatile and water soluble so may be either diluted in a dust diluent or in water before application to seeds. As a fungicide it compares favorably with ethyl mercuric phosphate or ethyl mercuric chloride. The cost of the chemical precludes its commercial development at present.

A material marked 154-6B containing 5% of betachloroethyl-ethoxymercuryhydroxide proved to be an excellent fungicide. Since the chemical is too expensive to be used at this dilution the strength was reduced with french talc to 1, 2, 3 or 4%. The 3 and 4% dusts were very effective and highly dependable. The 1 and 2% dusts controlled superficial molds but did not always eliminate all of these fungi.

Another non-mercurial organic ferric dimethyl dithiocarbamate or "Fermate" has been suggested as a laboratory fungicide. Recent tests at Geneva prove that it reduces the percentage of mold-infested seeds often completely eliminating both molds and bacteria. This chemical is not as dependable as those of ethyl mercury group even when used 20 to 50 times as strong.

The adherence of the material to the seed is an important factor in the laboratory method of treating small samples. Any material containing talc as the diluent is a reasonably adhesive. Approximately two ounces of the dust will adhere to one bushel of large farm seeds or a rate of 0.209% by weight. In practice this rate varies widely for small lots of seeds. For example with Thiosan on peas the rate is about 0.15% but varies from 0.06 to 0.25% depending on excess of chemical in shaking flask and thoroughness of sieving off the excess dust.

SUMMARY

Seed treatment is practiced to allow viable seeds to develop into normal plants. Any practice which prevents the action of microorganisms on seeds and seedlings reduces the gap between field stand and laboratory emergence. Pure organic chemicals containing no heavy metals are being increasingly popular.

Spergon is an excellent protectant against damping-off. It is easily adapted to laboratory use by mixing with clay, celete, talc, gypsum, or flour.

Two materials known only as U.S.R. #601 and U.S.R. #604 satisfactorily control molds in the laboratory but both chemicals are injurious to some seeds. Bromanil is far inferior to Chloranil (Spergon). Thiosan is an excellent protectant and may be applied to any seed safely. DuBay 1228E, an organic mercurial reduces incidence of molds on large seeds. Ethyl mercury tartrate, 154-6B and Fermate are all new materials of probable laboratory usefulness.

TABLE 1. - Influence of certain chemicals on the germination and microorganic contaminants of cucurbit seeds and green weight of the seedlings produced in laboratory tests.

Kind of seed	Germination		Seeds or seedlings contaminated with						Green weight of seedings		Chemically injured seedlings	
			Rhizopus spp.		Penicillium spp.		Bacteria					
Name	%		%		%		%		Grams		%	
ORGANIC COMPOUNDS CONTAINING NO MERCURY												
Ferricdimethyldithiocarbamate dust (Fermate)												
Cucumber	*85	°87	*57	°0	*0	°0	*0	°0	*18	°17	-	°0
Muskmelon	84	91	15	0	3	0	0	0	20	21	-	0
Squash	83	85	31	1	0	0	4	1	41	34	-	5
Spergon 40% - talc 60% as dust												
Muskmelon	39	56	100	19	0	0	0	0	19	25	-	0
Squash	51	69	79	45	30	2	0	0	56	62	-	0
Spergon 60% - talc 40% as dust												
Cucumber	93	91	15	4	0	0	0	2	15	12	-	15
Muskmelon	78	84	49	0	37	0	14	0	27	25	-	0
Squash	89	87	54	43	0	0	4	5	55	43	-	5
Spergonex - 1% suspension												
Cucumber	90	90	80	2	0	0	0	0	18	18	-	0
Muskmelon	55	70	39	0	0	0	0	0	18	14	-	30
Squash	89	92	22	1	0	0	0	0	51	41	-	33
Thiosan as dust												
Cucumber	73	76	12	3	3	0	0	0	13	12	-	3
Muskmelon	76	75	38	1	16	0	16	1	17	17	-	4
Squash	62	67	18	1	23	1	26	2	43	45	-	0
U.S.R. #601 - 25%; talc 75%												
Cucumber	81	85	40	4	2	1	3	1	19	20	-	0
Muskmelon	79	85	30	0	18	4	9	0	19	21	-	0
Squash	75	80	51	7	3	3	1	1	33	31	-	4
U.S.R. #601 - 33%; talc 67% as dust												
Cucumber	91	92	9	1	0	0	8	0	17	13	-	15
Squash	91	94	32	0	1	0	9	0	46	38	-	9
U.S.R. #601 as dust												
Cucumber	93	93	0	0	0	0	0	0	26	11	-	77
Muskmelon	89	90	69	0	2	0	16	1	12	9	-	69
Squash	89	98	65	0	5	0	23	0	45	36	-	16
ORGANIC COMPOUNDS CONTAINING MERCURY												
Betachloroethylethoxymercuryhydroxide 1% ; diluent 99% as dust												
Cucumber	92	98	48	3	0	0	23	0	17	19	-	0
Muskmelon	87	90	72	8	0	0	17	3	16	15	-	0
Squash	85	96	93	4	13	0	18	0	38	36	-	2
Betachloroethylethoxymercuryhydroxide 4% ; diluent 96% as dust												
Cucumber	83	89	28	0	0	0	0	0	21	20	-	4
Squash	91	92	24	0	0	0	1	0	46	45	-	2
Watermelon	86	90	29	0	8	0	0	3	38	34	-	11

*The left of the two columns in each instance shows results from untreated (check) seeds.
°The right of the two columns in each instance shows results from seeds treated by material indicated.

Table 1 (Continued)

Kind of seed	Germination		Seeds or seedlings contaminated with						Green weight of seedlings		Chemically injured seedlings	
			Rhizopus spp.		Penicillium spp.		Bacteria					
Name	%		%		%		%		Grams		%	
	Betachloroethylethoxymercuryhydroxide 5% ; diluent 95% as dust											
Cucumber	*93	°95	*29	0	*1	°0	*3	°0	*18	°16	-	°9
Muskmelon	95	95	84	1	0	0	6	0	16	17	-	2
Squash	89	93	67	2	0	0	13	1	48	44	-	3
	Ceresan as dust											
Cucumber	90	93	36	1	0	0	8	0	19	19	-	3
Muskmelon	92	92	55	7	0	0	7	2	15	16	-	0
Squash	84	92	93	1	11	0	9	0	41	28	-	37
	Ethyl mercuric tartrate .009% aqueous solution											
Cucumber	86	90	36	8	17	1	3	1	18	18	-	0
Squash	94	96	64	5	7	1	29	1	54	54	-	3
	Ethyl mercuric tartrate 0.02% aqueous solution											
Cucumber	96	97	8	0	0	0	4	0	23	19	-	7
Muskmelon	66	84	53	1	3	0	7	0	15	12	-	15
Squash	72	86	73	9	7	4	13	1	44	39	-	3
	New I. Ceresan - 0.10% aqueous suspension											
Cucumber	88	88	2	0	0	0	0	0	20	19	-	0
Muskmelon	91	88	37	0	1	0	1	0	22	20	-	12
Squash	86	88	51	3	0	0	0	0	41	37	-	3
Watermelon	79	87	73	0	12	0	19	0	43	43	-	0
	New I. Ceresan - 0.12% aqueous suspension											
Cucumber	96	95	23	0	0	0	12	0	16	17	-	2
Muskmelon	82	84	12	0	1	0	1	0	15	13	-	6
Squash	82	90	68	2	3	0	24	0	39	37	-	6
Watermelon	87	90	93	0	3	0	31	0	35	37	-	0
	New I. Ceresan - 0.15% aqueous suspension											
Cucumber	95	95	13	0	0	0	3	0	18	15	-	14
Muskmelon	64	61	59	0	0	0	23	0	16	14	-	18
Watermelon	85	82	48	0	0	0	16	0	42	39	-	8
	New I. Ceresan - 0.20% aqueous suspension											
Cucumber	94	95	12	1	0	0	4	0	24	19	-	11
Squash	62	80	87	4	3	0	26	1	38	41	-	6
	New I. Ceresan 40% - Celite 60% as dust											
Cucumber	93	96	42	0	0	0	4	1	21	19	-	3
Muskmelon	84	89	32	0	5	0	5	0	15	16	-	5
Squash	95	98	48	0	0	0	3	1	44	39	-	7
	New I. Semesan Jr. as dust											
Muskmelon	87	94	76	11	5	0	16	1	13	14	-	2
Squash	69	86	54	0	0	0	0	0	34	34	-	0
Watermelon	79	93	69	9	21	0	36	9	33	39	-	0
	Semesan as dust											
Cucumber	90	94	34	1	0	0	0	0	14	12	-	13

*The left of the two columns in each instance shows results from untreated (check) seeds.

°The right of the two columns in each instance shows results from seeds treated by material indicated.

VIABILITY OF BULBLETS OF ALLIUM CANADENSE AND A. VINEALE OCCURRING IN SEED OF CEREALS AND CRIMSON CLOVER
(A progress report)

O. L. Justice and M. D. Whitehead

Department of Agriculture and Industries, Montgomery, Alabama

The importance of Allium canadense and A. vineale as weeds is indicated by the fact that they have been declared noxious under the seed laws of the District of Columbia, every state in the South, except Louisiana, and the following adjoining states: Pennsylvania, Ohio, Indiana, Illinois, and Oklahoma. In Alabama, bulblets of A. vineale are frequently encountered in seeds of cereals and Crimson clover, and bulblets of A. canadense are occasionally found in seeds of the cereals. A high proportion of these bulblets have been found to be badly damaged in the threshing and cleaning processes and others seem to have been harvested when immature. The purpose of this investigation was to determine, as nearly as possible, the ability of these questionable bulblets to produce plants under field conditions. Because the bulblets used came from several sources, and the methods employed for different experiments varied, the experimental data and methods and materials can best be presented under the respective experiments.

EXPERIMENTAL

Experiment I. Mature bulblets of A. canadense harvested by hand on May 17th and of A. vineale on June 29th near Montgomery, Alabama were planted at a depth of about 1 centimeter in greenhouse flats of sand. The plantings of A. canadense were made on June 2nd and of A. vineale on July 2nd. Four flats of 100 bulblets each constituted a test. Bulblets of each species were tested (1) in a greenhouse and (2) in dense shade in the open where the temperature was considerably lower than in the greenhouse. The sand was kept moist at all times. At the end of ninety days none of the bulblets in either of the two tests had germinated.

In addition to the above tests bulblets of both species, taken from oats which had been harvested in June, were placed between germinating blotters at 20 - 30°C alternating temperatures, in October. At the end of fourteen days all the bulblets of A. vineale had decayed. At the end of forty-five days all of the bulblets of A. canadense were firm and none had developed shoots, although a few had developed roots. These tests showed (1) that bulblets of these species were dormant at the time of maturity and retained this dormancy for at least four months and (2) that it was necessary to find methods of overcoming the dormant condition before reliable germination tests could be made on the immature and injured bulblets.

Experiment II. This experiment was planned to determine favorable germinating and storage conditions for Allium bulblets so that the results obtained from questionable bulblets would not be influenced by a possible dormant condition. Bulblets, used in this experiment, were taken from oats grown in central Alabama and harvested with a combine in early June. Bulblets of A. vineale that would pass through a 3 mm sieve but not through a 2 mm sieve and which were solid when felt with forceps were used. The size limits of bulblets of A. canadense were not taken, but they were solid and much larger than any of those of A. vineale used.

On October 2nd bulblets of each of the two species were placed between germination blotters and exposed to daily alternating temperatures of

20 - 30°C and in petri dishes between moist cotton at each of the following temperatures: (a) 10 - 20°C daily alternating, (b) 2 - 20°C daily alternating, (c) 10°C, (d) 2°C constant. The bulblets exposed to alternating temperatures were placed at the lower temperature for approximately sixteen hours and at the higher temperature for eight hours. A few bulblets of each species were stored at 2°C in damp sandy loam soil which were later germinated at room temperatures. Bulblets exposed to 10°C and 2° degrees C constant temperatures were germinated at irregular intervals on moist cotton in petri dishes exposed to room temperatures and diffuse light, with the exception that some parallel tests were made in a dark chamber at 20 degrees C constant temperature. The germinating conditions for bulblets exposed to alternating temperatures were the same as the storage conditions stated above under (b) and (c). A complete record of the results of this experiment is given in Table 1.

Although the results presented in Table I are not conclusive, certain points are brought out which are valuable guides in continuing the investigation. The mean percentage of germination obtained from all bulblets of A. vineale stored at 10°C was 15, while the mean for bulblets stored at 2°C was 21. This indicates that a temperature of 2°C is slightly more favorable than 10°C for bulblets of this species, but the difference is not great enough, with the small number of bulblets used, to warrant a statement as to which of the two temperatures was more favorable. In the storage tests alternating temperatures showed no advantages over constant temperatures and sand as a stratifying medium showed no advantage over moist cotton. Prechilled bulblets germinated better when exposed to room temperatures and diffuse light than when exposed to dark germinating chambers held at 20°C. The 10°C temperature proved to be more favorable for the afterripening of bulblets of A. canadense than the other temperatures employed, but again the number of bulblets used was too small to make a positive statement. Forty-eight per cent of the bulblets of this species germinated over an eight-month period when exposed to 20 - 30°C for three months and at room temperatures for five months. Since all the bulblets of both species used in this test were firm when placed in storage and high percentages decayed, this suggests that further study should be made on methods of breaking dormancy in solid bulblets before the actual viability of questionable bulblets found in agricultural seed can be determined.

Experiment III. For this experiment a location near Montgomery, where Allium canadense was known to have produced a crop of bulblets during the spring of 1941 was selected. On November 29, 1941, this location was visited and 378 bulblets which were lying on the surface of the soil and those buried as deep as 1 1/2 inches were collected and observed. The results of the observations of these bulblets are as follows; (1) neither roots nor shoots developed, short axis 2 - 6.5 mm. - 64 bulblets or 16.9% per cent; (2) no roots but with very short shoots developed, short axis 2 - 4.5 mm. - 36 bulblets or 9.5%; (3) roots developed but no shoots, short axis 2-6 mm. - 108 bulblets or 28.6%; (4) both shoots and roots developed, short axis 2 - 6 mm. - 170 bulblets or 45.0 per cent.

Experiment IV. Bulblets of A. vineale taken from oats grown in central Alabama and from Crimson clover grown in northern Alabama were used in this experiment. The bulblets were classified on the basis of weight as separated by an Iowa air blast separator and on size. The various classifications are listed in Table 2. In making the blowings, the cup (used for grasses) was filled to about one-half its capacity and the bulblets blown for five minutes. The sizes shown in Table 2 represent the axis of the

TABLE I. - Germination Results Obtained from Bulblets of Allium Vineale and A. Canadense which had Been Stored Between Moist Cotton and in Moist Sand at Four sets of Temperatures

Storage temperatures from 10-2-41 Until test date	Germinating conditions	Period of Germination test	A. vineale			A. canadense		
			No. used	% Germ.	%Firm	No. used	% Germ.	% Firm
None	20 - 30°C between blotters	10/2/41 - 5/27/42	100	0*	0	50	48**	0
10°C constant	20°C constant	10/28/41-1/3/42	25	32	8	-	-	-
2° C constant	20°C constant	10/28/41-1/3/42	25	12	4	-	-	-
10°C constant	Room temp.-constant	10/28/41-1/3/42	25	40	0	-	-	-
2° Cconstant	Room temp. constant	10/28/41-1/3/42	25	20	4	-	-	-
10°C constant	Room temp. constant	11/18/41-1/21/42	150	20	2	50	34	6
2° Cconstant	Room temp. constant	11/18/41-1/21/42	25	20	12	50	8	8
10°C constant	Room temp. constant	1/3/42-5/27/42	-	-	-	25	52	0
2° Cconstant	Room temp. constant	1/3/42-5/27/42	50	40	0.5	50	30	4
2° Cconstant	Room temp. constant	3/4/42-4/13/42	15	80	0	-	-	-
10 - 20°C altern.	10 - 20°C. altern. daily	10/2/41-1/21/42	100	22	0	-	-	-
2 - 20°C altern.	2 - 20°C. altern. daily	10/2/41-1/21/42	100	13	0	-	-	-
2° Cconstant, - in moist sand	Room temp. constant - in moist sand	11/18/41-3/4/42	75	24	0	50***	30	8

*All bulblets had decayed at the end of 14 days.
**On January 3rd the 19 remaining bulblets were transferred to cotton in petri dishes and placed at room temperatures. All of these had germinated by May 27th.
***Period of germination test for this sample was 1/3/42 - 3/26/42

short diameter of bulblets. These are not absolute values due to variations in shape and the relative proportion of the short to the long axes. In classifying the macerated bulblets considerable personal judgment was necessarily exercised.

The bulblets were planted in greenhouse flats of sandy loam soil at a depth of about 1 cm on December 6, 1941. The flats were covered with 6 mm wire netting (hardware cloth) and sunk in a field so that about 25 mm of the flat projected above the surface of the surrounding soil. Soil was then packed around each flat securely. The flats were located in a sandy field near Montgomery where Allium vineale was growing. On April 20th all the flats were transferred to a greenhouse where they were watered regularly. Observations were made on March 7th, March 28th, April 20th, and May 28th. The results of this experiment are shown in Table 2.

TABLE 2. - Germination Results Obtained from Bulblets of Allium Vineale Which Had Been Planted in Soil and Exposed to Field Conditions

Classification of Bulblets	No. Used	No. Germinating	Germination
	Bulblets Taken from Oats		%
I. Blowings at manometer 48 mm			
1. Small bulblets, hulls attached	120	1	0.8
2. Large " " "	170	0	0.0
II. Blowings at manometer 66 mm			
3. Hulled; small, similar to ones in crimson clover	400	0	0.0
4. Unhulled; 1-2 mm. in size	400	1	0.25
5. " 2-3 mm. in size	400	1	0.25
6. " 2½-4 mm. in size	400	1	0.25
III. Blowings at manometer 82 mm			
7. Hulled; small, not macerated	400	0	0.0
8. " partially macerated	400	2	0.5
9. " badly macerated	400	2	0.5
10. Unhulled; small, macerated	110	0	0.0
11. " not macerated 1-2½mm	400	36	9.0
12. " " " 2-3 mm	400	7	1.75
13. " " " 2½-4½mm	400	3	0.75
IV. Residue at manometer 82 mm			
14. Hulled; not macerated	400	0	0.0
15. " partly macerated	400	0	0.0
16. " badly macerated	400	0	0.0
17. Unhulled; not macerated 1½-2½mm	400	130	32.5
18. " " " 2½-3½mm	400	131	32.75
19. " " " 3½-4½mm	400	71	17.75
20. " " " 4½-7mm	40	16	40.00
21. Hulled; " " 7½mm plus	24	1	4.1
	Bulblets taken from Crimson clover		
22. Unhulled; not macerated 2-4 mm	400	45	11.25
23. Hulled; macerated	400	0	0.0
24. Hulled; not macerated	400	0	0.0
	Solid bulblets received from Oklahoma A. and M. College		
25. Unhulled; 3-8 mm sound	100	62	62

It is seen that bulblets from which the husks had been removed germinated very poorly. Of the small and average sized bulblets the maximum germination was 0.5 per cent. Only one out of twenty-four very large bulblets from which the husks had been removed germinated (Series No. 21). Of all bulblets removed by blowing at 48 mm and 66 mm the maximum germination obtained was 0.8 per cent. Excepting Series 11, only the heavier, unhulled and undamaged bulblets gave appreciable percentages of germination. It is not clear why 9.0% germination was obtained in Series 11 and only 1.75% and 0.75%, respectively, were obtained from Series 12 and 13, which were larger bulblets. The same inconsistency was observed in Series 19 when compared with Series 17, 18, and 20.

Unhulled and apparently uninjured bulblets taken from crimson clover germinated only 11.25%, while none of the hulled bulblets germinated. Best germination (62%) was obtained from the solid bulblets received from Oklahoma.

Experiment V. Some of the bulblets of A. vineale separated out from oats for use in Experiment IV were used in this experiment. Two hundred bulblets from each of Series 11, 18, and 19 were planted in sand in a greenhouse on March 28th after continuous storage in the laboratory. At the end of sixty days the following germination percentages were obtained: Series 11 - 1.5%; Series 18 - 15.5%; Series 19 - 12.0%. In addition to these, 100 bulblets of those obtained from the Oklahoma A. and M. College were tested, which germinated 53 per cent. When these results are compared with those reported in Table 2 it is seen that the bulblets, which had been stored in the laboratory, germinated less than those planted in the field in each instance - Series 11 - 7.5% less; Series 18 - 17.25% less; Series 19 - 5.75% less. This experiment shows that the dormancy of firm bulblets is broken in a shorter period of time when planted outdoors under field conditions than when stored dry in a laboratory.

Experiment VI. Bulblets of A. vineale taken from recleaned crimson clover grown in northern Alabama were used in this experiment. They were harvested in June 1941 and kept in dry storage until tested from June 26 to July 26, 1942. The husks from the bulblets had been removed in harvesting and cleaning. They were of such size and weight that they could not be removed from crimson clover with ordinary screening and blowing machinery. Germination tests were made in sand, kept slightly moist at all times, at a depth of 5 - 10 mm. Each test consisted of 4 x 100 bulblets placed in paper germinating boxes or 2 x 200 bulblets placed in greenhouse flats. The temperatures to which the bulblets were exposed are shown in Table 3.

TABLE 3. - Effect of Temperature on Germination of Bulblets

Germinating Temperature	No. Bulblets Used	No. Germinating	Germination
			%
10 degree constant	4 x 100	2	0.5
20 degree constant	4 x 100	0	0
30 degree constant	4 x 100	0	0
10-20 degrees alternating	4 x 100	0	0
10-30 degrees alternating	4 x 100	0	0
20-30 degrees alternating	4 x 100	0	0
20-35 degrees alternating	4 x 100	0	0
Greenhouse	2 x 200	0	0
Outdoors in dense shade	2 x 200	0	0

If very many of these bulblets had been viable it would appear that these would have germinated under some of the germinating temperatures. The two seedlings obtained at 10 degrees C appeared weak but they were in a dark chamber during the test. Many of the ungerminated bulblets were known to have decayed but none could be found in the sand which had not decayed.

Discussion

It is significant to point out that the results obtained in this investigation are not conclusive and, alone, cannot be used as a basis for changing the rules relating to definitions of noxious weed seed. The results indicate quite clearly that very low percentages of the hulled bulblets found in crimson clover, and of injured bulblets found in cereals, can be expected to produce plants under field conditions. Experiments designed to obtain good germination results from firm bulblets were disappointing and no general conclusions can be drawn from them. Bass and Hooker[1] reported on the germination of "Wild Onion" bulblets and stated that they were "placed to germinate at the established optimum temperature (20-30°C)". They did not present data to support this statement nor give reference to previous work. Field and laboratory observations made by the writers indicate that this is not the optimum germinating temperature for either of the two species.

Further work must be done and more field observations made on bulblets known to be viable before the work with questionable bulblets is continued. To this end the writers have harvested large quantities of bulblets of both species and storage experiments have already been begun.

PERSISTENT HARDSEEDEDNESS IN EARLY PERFECTAH PEAS[1]

Willard Crosier and Stewart Patrick

New York State Agricultural Experiment Station, Geneva, N. Y.

In 1937 a stock of Early Perfectah peas grown by the Washburn-Wilson Seed Company was sampled and placed in a 20°C germinator for a routine germination test. At that time 17% of the seeds remained firm after a 6-day test. In later studies the percentages of hard seeds (6-day period) varied from 10 to 19. In a series of experiments Patrick and Crosier[3] found the swelling periods for 100-seed lots ranged from 20 to 47 days. The percentage of viability was slightly greater for seeds unswollen after a 6- to 15-day soak in water than for those promptly permeable to water. A small bulk of this stock was secured and stored in a warm laboratory. On June 17, 1941 another series of experiments were undertaken to determine if the hardseededness still persisted. Accordingly 4,000 seeds were placed in water held at 20°C. The swollen seeds were removed at certain intervals and placed on paper towels for a germination test. The results

1. Bass, C. M. and Dorcas Hooker. Wild Onion bulblets. Proc. Assoc. Off. Seed Anal. 1941:42-43. 1941.
2. Journal Paper No. 576 of the New York State Agricultural Experiment Station, Geneva, New York.
3. Patrick, Stewart and Willard Crosier. Commercial significance of hard seeds in peas. Proc. Assoc. Off. Seed Anal. N. Am. 1937:146-147. 1937.

as expressed in Table 1 prove that the viability of the seed stock decreased only slightly during storage. The data also show that the promptly germinating seeds were slightly less viable than those swelling after a 25-hour period. These percentages are; seeds swollen in 25 hours, 68.8 and seeds swollen after 25 hours, 83.3.

TABLE 1. - Rate of swelling and the viability of seeds of Early Perfectah Peas, soaked in water at 20°C.

Soaking		Seeds swollen	Seeds hard	Germination of swollen seeds[a]
Days,	Hours	No.	No.	%
0	0	0	4000	--
0	15	3763	237	68.8
1	1	18	219	72.3
11	13	21	198	75.0
2	20	20	178	80.0
3	20	15	163	93.3
4	20	14	149	92.6
7	1	34	115	79.4
8	0	14	101	100.0
10	0	21	80	100.0
12	0	31	49	80.5
14	18	17	32	82.4
15	18	11	21	100.0

[a]Refers to seeds swollen since last reading.

Seeds of the Early Perfectah bulk were also placed in various substrates and held at 20°C. The water content was adjusted to 60% of the water holding capacity of each type of substrate. The percentages of germination as averaged in Table 2 prove that sprouts emerged first in the sand lots. A few of the seeds were destroyed by soft-rotting bacteria. The hard seeds were counted after a 50-day germination period. All of the seeds in the peat and clay tests had swollen within 50 days. The periods for complete swelling were of about the same lengths for water soaks, moist towels, muck and sand and clay mixture.

In order to study the influence of temperature on rate of swelling peas were placed at 10, 15, 20, 18-25, 25 and 30°C. Counted lots of 4,000 seeds were held in accurately controlled water baths. The swollen seeds were removed at various intervals as outlined in Table 3. The data prove that the rate of swelling increases as the water soak becomes warmer.

The peas remaining impermeable to water after a 6-day soak in 1937 were held in room storage until 1941. Lots of 1,000 seeds were placed in water at 10, 15, 20, 25 and 30°C in March of 1941. The results are expressed graphically in figure 1. The relationship between temperature and rate of swelling is evident. The periods of time in days required to complete swelling are: 10°C-215, 15°C-165, 20°C-98, 25°C-47, and at 30°C-38 days.

In another experiment 3,000-seed lots were soaked in water at 15, 20 and 25 C. The swollen seeds were removed at intervals of 1, 2, or 5 days and immediately placed on moist towels. The germination percentages of all of the seeds swollen within 2 days are: 15°C-80.3, 20°C-84.2, and 25°C-71.2. The average germinations of the seeds swelling after the first 2 days of

TABLE 2. - Germination of seeds of Early Perfectah Peas in certain substrates or in water at 20°C.

Substrate	Seeds germinated in 1 to 50 days							Seeds unswollen			
	1 Day	5 Days	10 Days	15 Days	20 Days	35 Days	50 Days	50 Days	60 Days	70 Days	85 Days
	%	%	%	%	%	%	%	%	%	%	%
Water	*66	*68	*72	*77	*82	*94	*98	2	2	1	0
Wet towels	*58	*67	*65	*74	*81	*96	*98	2	2	1	0
Steamed peat	-	1	66	69	81	89	91	0	0	0	0
Steamed muck	-	1	49	53	71	79	79	2	1	1	0
Steamed sand	-	48	59	63	78	92	96	2	2	2	1
Steamed sand and clay	-	16	44	51	65	74	75	1	1	1	0
Peat	-	0	*63	70	85	95	97	0	0	0	0
Clay	-	12	42	48	70	81	83	0	0	0	0

*Seeds swollen and in part producing sprouts, all other percentages in these columns are cumulative and represent total germination to date.

TABLE 3. - Rate of swelling of seeds of Early Perfectah peas stored in a warm laboratory since 1937 and placed in water on March 8, 1941

Temperature of water, °C	Seeds swollen in water baths after												
	1 Day	2 Days	5 Days	10 Days	15 Days	20 Days	25 Days	35 Days	50 Days	65 Days	80 Days	100 Days	120 Days
	%	%	%	%	%	%	%	%	%	%	%	%	%
10	73	84	88	92	93	94	95	97	98	99	99.5	99.5	100
15	88	93	96	97	97	97	98	99	99.5	99.5	100		
20	88	94	95	96	97	98	99	99.5	99.5	99.5	99.5	100	
18-25	91	92	94	96	95	96	97	98	99	100			
25	90	94	95	97	99	99.5	100						
30	96	97	98	99	99	99.5	100						

this experiment are: 15°C-94.1, 20°C-80.6 and 25°C-100. The rates of swelling and germinations of seeds becoming permeable in a 1, 2 or 5-day period are shown in Table 4.

Unselected peas from the Early Perfectah seedstock were also soaked in water baths at higher temperatures. In one experiment the percentages of swollen seeds at 50°C were: 20 minutes-30, 40 minutes-75, and 90-minutes-89%. The germination of the swollen seeds was approximately 65% irrespective of the period of soaking. The hard peas removed in 20, 40 and 90 minutes contained 84, 84 and 91% of viable seeds respectively.

The rate of swelling of pea seeds is more rapid at 40 and 50°C than at lower temperatures. As shown in Table 4 no hard seeds remained in a water bath at 50°C after 10 days. The seeds which became swollen in any 5 day period were left in the 40 or 50°C bath until the end of this interval. The germination percentages are low because most of the seeds were exposed to moist heat for 1 to 5 days. The longevity of hard seeds in hot water baths

TABLE 4. - Rate of swelling and percentage of germination of seeds of Early Perfectah peas in moist towels

Temperature of towels	Seeds swollen or germinated in moist towels											
	1 Day	2 Days	3 Days	5 Days	10 Days	15 Days	20 Days	25 Days	30 Days	35 Days	40 Days	45 Days
	%	%	%	%	%	%	%	%	%	%	%	%
15°C												
*swollen	90	94	95	95	96	96	98	99	99	99.5	99.5	100
**germinated	80	81	100	67	100	67	100	100	100	100	100	100
20°C												
*swollen	93	94	95	96	98	99	99.7	99.8	100			
**germinated	84	100	67	75	58	100	100	100	100			
25°C												
*swollen	96	97	97	98	98.5	99.3	99.7	99.8	99.8	99.8	99,8	100
**germinated	70	89	100	100	100	100	100	100	--	--	--	100
40°C												
*swollen	96	97	98	99	99.8	99.9	100					
*germinated	80	70	81	55	40	20	0					
50°C												
*swollen	95	96.5	98	99.9	100							
**germinated	59	80	8	3	0							

*Percentage of total seeds swollen since start of test.
**Percentage of germination of seeds swelling within the last 1-, 2- or 5-day period.

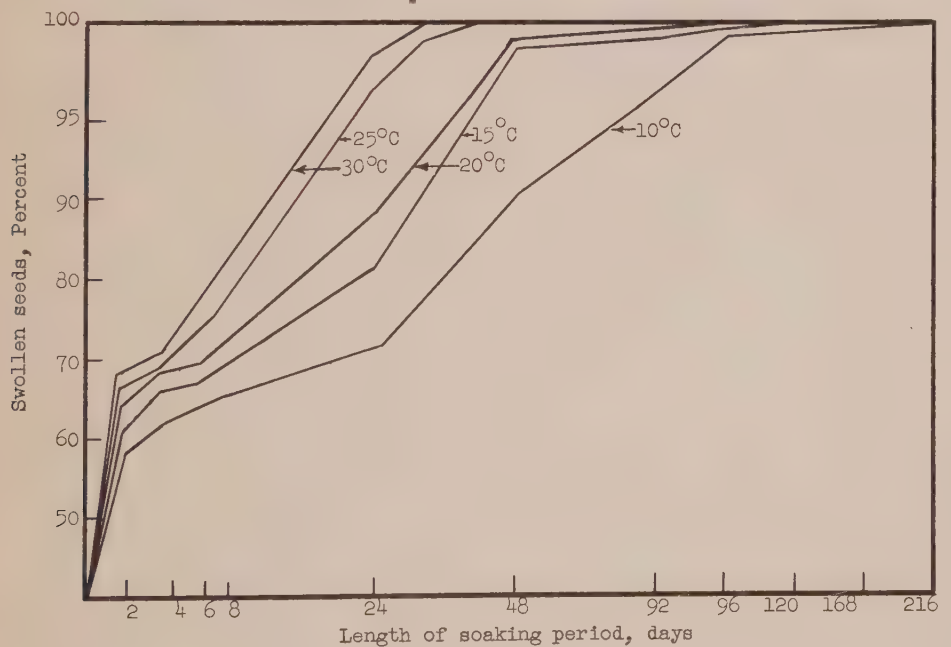


Fig. 1

appears to parallel that of seeds in dry hot air. It is known that swollen peas held at 50°C are killed in 1 day. A high percentage will not survive moist heat (50°C) for more than 3 hours. In several tests a number of peas remaining unswollen after a 30-hour soak at 50°C were placed to germinate. From 86 to 100% of these seeds were viable.

Summary

A stock of Early Perfectah peas grown in 1936 contained 17% of hard seeds (in 6-day test) in laboratory tests completed in 1937. A sma. bulk of this seed was stored at room temperature until 1941.

The viability of this stock decreased only slightly during 4 years of storage. The promptly swelling peas contained 69% of viable seeds and the tardily swelling peas, 83%.

In water, towels, sand, peat, muck, clay or in mixtures of the soil types approximately 70 days were needed to complete swelling of all seeds. The 4,000 seed lots of peas held in water swelled more rapidly as the temperature was increased. The times to complete swelling of all seeds were: 10°C-120 days, 15°C-80 days, 20°C-90 days, 18-25°C-65 days, 25°C-25 days, 30°C-22 days, 40°C-20 days, and 50°C-10 days.

Hard seeds in water baths are not actually exposed to moist heat. Whereas swollen peas are rapidly killed in water baths at 50°C, the longevity of the unswollen seeds appears to parallel that of seeds in dry air.

Peas which remained impermeable in a 6-day soak in 1937 were stored and placed to germinate in 1941. In experiments of 3,000-seed lots the following times were required to complete germination; 10°C-215 days, 15°C-165 days, 20°C-96 days, 25°C-47 days and 30°C-38 days.

BALDHEADS IN BEANS, OCCURRENCE AND INFLUENCE ON YIELDS[1]

Willard Crosier

New York State Agricultural Experiment Station, Geneva, N. Y.

The terms "baldheads" and "baldheadedness" have been loosely applied to cover various degrees of abnormalities in legumes. In general the baldheads as viewed in the laboratory result from mechanical injury and are evidenced by a failure of the epicotyl development.

Since splits are definitely the result of a mechanical injury caused by threshing and by other phases of seed processing a germination test accurately reveals their existence. "Splits," in relation to germinability, are seeds characterized by a separation of the cotyledons from the remainder of the embryo at any time prior to depletion of their nutrient content. Such a condition is easily observed in the laboratory but also occurs in the field. The plumule or epicotyl is not injured so a plant once established in the field usually fruits although sparsely and tardily.

The determination, classification and evaluation of the "baldhead" type of germinants or field seedlings present a troublesome problem. "Baldheads," or plants in which the plumule has been destroyed, are determined in the laboratory only if the cotyledons are separated sufficiently wide to permit observation of the epicotyl tip. This necessitates either a manual removal or splitting of the seed coats of the beans or a 10- to 20-day germination period to permit natural shedding of the seed coats. The problem is further complicated by the fact that baldheads in the field are due to (1) injury of the dry seed during processing, (2) stone, cultivator,

1. Journal Paper No. 581 of the New York State Agricultural Experiment Station, Geneva, N. Y.

corn maggot, wireworm, etc., injury in the field, or (3), chemical injury induced by excessive or misplaced fertilization. Experienced bean growers are of the opinion that the percentage of baldheads as determined in a greenhouse or laboratory shows little or no relation to actual field performance. They believe that corn maggots or wireworms are the chief contributing factors to baldheads.

Experts in bean production insist that splits and baldheads are separate and distinct forms of injury. In the former abnormality the cotyledons are weakly attached or detached entirely from the growing portion of the embryo, while in the latter the growing tip or plumule is injured so that an epicotyl develops tardily if at all. Both scientists and seedsmen in New York State have generally believed that baldheads as well as "splits" could not contribute to yields in the field. Recently, however, certain seedsmen have stated that splits and baldheads may often develop into useful plants. They insist that the exclusion of laboratory splits and baldheads from the counts of normal germinants is unjustified.

In an attempt to answer these questions certain varieties of snap and dry-shell beans have been studied in the laboratory, greenhouse and field. Since many of our germination tests did not demonstrate the presence, or number, of baldheads no correlation between laboratory and field can be established. The percentage of splits, however, was determined for several lots of canning varieties of snap beans. In Table 1 the laboratory germination percentages are compared to those for normal and baldhead plants in the field. The results from the Brittle Wax seedstocks negate any definite correlation between splits and normal plants or between splits and baldheads. The relationship between laboratory and field germinations is evident in a study of the results from the refugee types. It is plain, however, that the percentage of splits seeds in no degree correlates with the percentage of baldheads observed in the field. The data in Table 2 were obtained from both dry shell and snap beans germinated and planted in 1941 and 1942.

It is interesting that field emergence usually bears no relationship to laboratory germination. Under normal conditions the field emergence is considerably lower than the percentage of normal germinants in the laboratory or in the greenhouse. The percentage of baldheads may be more or less than the percentage of splits in the towel tests. The behavior of these seedstocks in greenhouse soil also strongly indicates that baldheads in the field are the result of environmental agents subsequent to, rather than prior to, planting. The results from the Blue Lake refugee lots grown in protected greenhouse beds show that (1) splits do not produce normal plants and (2) the percentage of baldheads may be either more or less than that of split seeds. The term "recovered baldheads" refers to plants with an abundant epicotyl growth originating from adventitious buds while "not recovered" refers to plants with little or no growth above the cotyledons.

Statements that baldheads cannot be of value in producing a crop of canning beans are ambiguous and may be misleading. Statements creating the belief that baldhead plants are on a production level with normal plants are equally misleading. Under the most optimum growing conditions recovered baldheads produce pods but in a lesser number and at a later date than do normal beans. Reference to the yield of Black Valentine beans as presented in Table 3 gives credence to this statement. The ratio of pods per normal plant to pods per baldhead plant for four picking dates are: August 27, 24 to 1, August 31, 7 to 1, September 4, 14 to 5, and September 10, 14 to 5. The rows of Black Valentine beans were crowded and the normal plants shaded the baldheads.

The plantings of Brittle Wax and Green Refugee were thinned out to leave 25 to 30 normal plants in a 18 foot row. The baldheads were usually

TABLE 1. - Laboratory germination and field emergence of canning varieties of beans in 1940.

Sample	Laboratory germination		Plants in field (35 days)			
	Normal	Splits	Normal		Baldheads	
	Range	Range	Range	Average	Range	Average
	%	%	%	%	%	%
			Brittle Wax Beans			
2	95 - 98	0 - 3	56 - 82[1]	64.5[2], 60.0	3 - 4	[1]2.5, [2]5.0
9	90 - 94	4 - 10	53 - 70	63.1, 72.8	2 - 11	7.7, 4.4
6	85 - 89	8 - 15	56 - 73	64,0, 66.5	2 - 7	6.2, 7.0
7	80 - 84	13 - 20	53 - 73	61.7, 68.7	2 - 13	7.4, 5.0
	Common, Idaho M. R. and Wisconsin M. R. Refugee Beans					
1	95 -	4 -	- -	68.0, -	- -	6.0, -
12	90 - 94	4 - 10	56 - 86	71.1, 64.0	0 8	5.3, 3.8
8	85 - 89	8 - 15	56 - 77	70.6, 68.6	4 - 12	8.2, 4.4
4	80 - 84	13 - 20	51 - 83	63.0, 67.5	2 - 14	6.5, 5.6
2	75 - 79	16 - 25	43 - 60	58.0, 43.0	11 - 14	12.5, 11.0
1	64 -	34 -	- -	30.0, -	- -	3.0 -
			U.S. No 5 Refugee Beans			
2	95 - 98	0 - 3	71 - 85	83.0, 78.5	4 - 7	6.5, 4.0
11	90 - 94	4 -10	67 - 89	78.8, 74.7	2 --9	5.5, 4.3
12	85 - 89	8 -15	57 - 89	75.3, 70.1	0-12	5.1, 4.0
13	80 - 84	13 - 20	56 - 77	66.7, 77.2	0-12	6.8, 4.0
2	70 - 79	17 - 28	57 - 70	64.0, 63.5	3 - 4	4.0, 3.5
2	63 - 66	31 - 33	31 - 42	39.0, 36.5	6-11	9.0, 6.0

1. From seeds not treated prior to planting.
2. From seeds treated with a 2% ethyl mercuric tartrate dust prior to planting.

given adequate space to develop. The results in Table 3 represent the lowest "yield of normal" to "yield of baldhead" plants ratio that could be obtained for these varieties.

The yields of snap beans in 1941 were obtained from replicated rows of each seedstock planted with chemically-treated seed. As shown in Table 4 the average yield per normal plant varies from 3 to 8 times that of the average baldhead plant. It is also noticeable that the average yield per pod usually is greater for normal than for baldhead plants although in two lots the opposite was true.

Summary

Splits in beans are the results of mechanical injury. Baldheads are plants or seedlings in which the plumule has been destroyed. They are difficult to determine in the laboratory.

In the field baldheads may be caused by factors subsequent to planting and hence the incidence of baldheads in the field may not agree with the rate of occurrence in the laboratory.

There is slight correlation between splits and baldheads.

Splits do not produce normal plants.

Baldheads may produce pods but in a lesser number and more tardily than normal plants.

The yield of pods on snap beans in 1941 showed that "normals" outyield baldheads by from three to eight times. Usually the pods on normal plants are slightly heavier than those on baldhead plants.

TABLE 2. - Laboratory germination compared to soil emergence of beans in 1941 and 1942.

Laboratory Number	Laboratory germination		Soil emergence		
	Normal	Splits	Normal	Baldheads	
				Recovered	Not Rec.
	%	%	%	%	%
	Brittle Wax				
10346	95	5.	*61.	14	1
14046	96	4.	*73.	7	2
90	94	3.	°100.	0	0
91	91	8.	°90.	0	0
92	86	13.	°90.	0	3
93	87	12.	°85.	0	0
94	97	3.	°91.	0	0
Average	92.3	6.9	85.7	3.0	0.9
	Refugee type				
10077	92	7.	*71.	9.	0
10348	85	12.	*68.	12	0
12322	93	7.	*82.	5	0
12649	86	12.	*76.	4	0
14052	82	16.	*78.	3	0
14393	87	13.	*68.	3	0
88	97	2.	°91.	3	0
89	97	3.	°100.	0	0
Average	90.1	9.0	79.3	4.9	0.0
	Blue Lake Pole				
81	95	3.	°84.	6	3
82	100	0.	°96.	0	0
83	78	20.	°66.	9	3
84	97	2.	°94.	0	0
85	74	18.	°66.	6	6
86	97	2.	°84.	0	0
87	88	6.	°87.	0	0
Average	89.9	7.3	82.4	3.0	1.7
	Red Kidney				
9989	75	23.	*51.	6	1
10556	90	9.	*52.	9	0
12301	86	12.	*47.	10	1
12866	86	13.	*47.	10	0
13142	90	10.	*62.	6	1
13144	92	8.	*67.	11	1
13165	90	8.	*65.	12	2
14177	85	14.	*63.	13	1
14178	88	11.	*46.	6	0
Average	86.9	12.0	55.5	9.2	0.8
	Yellow Eye				
14249	86	10	*67	4	0
14250	87	11	*69	7	0
Average	86.5	10.5	68.0	5.5	0.0
	Henderson Lima				
14390	93	7.	*65.	5	2

*Grown in field
°Grown in greenhouse

TABLE 3. - Performance of garden beans in the field in 1940

Lot No.	BALDHEAD PLANTS					NORMAL PLANTS				
	Pods		Weight of Pods		Weight	Pods		Weight of Pods		Weight
	Total	Per Plant	Total	Per Plant	Per Pod	Total	Per Plant	Total	Per Plant	Per Pod
	No.	No.	Grs.	Grs.	Grs.	No.	No.	Grs.	Grs.	Grs.
BLACK VALENTINE BEANS - 1940										
9008	[1]12	0.12	33.5	0.34	2.79	1447	2.91	7017	14.12	4.85
	[2]86	0.89	291.0	3.00	3.38	3165	6.35	13617	27.40	4.30
	[3]208	2.14	772.0	7.95	3.71	2925	5.89	13230	26.61	4.52
	[4]169	1.75	785.0	8.98	4.64	2437	4.91	12924	26.00	5.30
Total	[5]475	4.90	1881.5	19.37	3.96	9974	20.06	46788	94.13	4.70
BRITTLE WAX										
3063	14	2.0	51.0	7.3	3.6	187	4.9	898	23.7	4.8
7799	32	4.0	163.0	20.4	5.1	162	5.4	952	31.7	5.9
10793	21	2.1	90.0	9.0	4.3	98	3.3	476	15.9	4.8
11694	17	2.4	70.0	10.0	4.1	150	3.8	694	17.4	4.6
11920	10	1.2	33.0	4.1	3.3	200	4.7	1033	24.6	5.0
GREEN REFUGEE TYPE										
10023	18	2.2	81.	10.2	5.1	694	17.60	3152	78.80	4.5
10019	44	7.3	143	23.8	3.3	823	19.1	3622	84.4	4.4
10026	32	3.2	138	13.8	4.3	546	18.3	2333	77.7	4.2
11916	20	4.0	96	19.2	4.8	560	10.0	2858	51.1	5.1
10027	58	8.3	191	27.3	3.3	477	14.3	2452	73.5	5.1
10496	32	4.0	137	17.1	4.3	666	15.9	3520	83.9	5.3
10023	55	4.6	367	30.6	6.6	430	11.9	2398	66.6	5.6
10025	20	3.3	107	17.8	5.3	387	7.7	2181	43.6	5.6
10950	26	5.2	109	21.8	4.2	505	10.5	2888	60.1	5.7
7675	47	5.9	222	27.7	4.7	469	12.4	2722	73.6	5.8
11153	26	3.7	139	19.9	5.4	477	13.3	2349	63.5	4.9
11148	42	4.2	124	12.4	2.9	494	10.1	2420	48.4	4.9
7674	55	4.6	276	23.0	5.0	379	11.8	2221	69.4	5.9
11146	72	6.0	339	28.2	4.7	520	12.4	3032	72.2	5.9
9338	81	8.1	420	42.0	5.2	524	13.8	3023	79.6	5.8
7590	22	4.4	61	12.2	2.8	414	7.1	2240	52.4	5.4
9342	36	6.0	172	28.6	4.8	521	10.2	3270	65.4	6.3
9338	52	5.2	320	32.0	6.2	347	11.6	2024	67.8	5.9
7591	13	2.6	29	5.8	2.2	549	10.2	2597	48.1	4.7

1. Pods picked on Aug. 27
2. Pods picked on Aug. 31
3. Pods picked on Sept. 4
4. Pods picked on Sept. 10
5. Total of pods for entire season

TABLE 4. - Field performance of canning varieties of beans in 1941 showing dry weights of seeds from normal and baldhead plants.

Lot No.	NORMAL PLANTS						BALDHEAD PLANTS					
	Plants	Pods		Beans dry wgt.		Weight	Plants	Pods		Beans, dry wgt.		Weight
		Total	Per plant	Total	Per plant	Per pod		Total	Per plant	Total	Per plant	Per pod
	No.	No.	Nc	Grs.	Grs.	Grs.	No.	No.	No.	Grs.	Grs.	Grs.
[1]10077	236	2509	10.7	2358	10.0	0.94	21	71	3.4	43	2.0	0.61
[2]10346	36	242	6.8	315	8.8	1.30	5	7	1.4	6	1.2	0.86
[1]10348	65	1804	27.8	2097	32.3	1.16	9	64	7.1	104	11.5	1.63
[1]12322	127	620	4.9	1024	8.1	1.65	21	22	1.1	22	1.1	1.00
[1]13649	161	2588	16.1	2793	17.4	1.08	16	36	2.3	63	3.9	1.75
[1]14046	218	1420	6.5	1781	8.2	1.25	30	66	2.2	37	1.2	0.56
[1]14052	179	3119	17.4	3507	19.6	1.13	20	54	2.7	45	2.3	0.83
[2]14393	200	2834	14.2	2301	11.5	0.81	17	37	2.2	26	1.5	0.70

1. Refugee type.
2. Brittle wax variety.

DISTINGUISHING CHARACTERS OF THE SEEDS[1] OF FOUR SPECIES OF AGROPYRON

A. repens (L.) Beauv., quackgrass; A. smithii Rydb., western wheatgrass; A. trachycaulum (Link) Malte,[2] slender wheatgrass; A. cristatum (L.) Gaerth.[3], crested wheatgrass

Albina F. Musil, Assistant Botanist
Division of Forage Crops and Diseases

UNITED STATES DEPARTMENT OF AGRICULTURE

Bureau of Plant Industry

Washington, D.C.

Several excellent papers describing the seeds of Agropyron repens, A. smithii, and A. trachycaulum have already been published, the most comprehensive of these being the studies by Dahlberg, Hillman, and Henry.[4] These publications, however, are no longer readily available for general use in seed laboratories so it seems desirable to present in brief form, with illustrations,[5] those diagnostic characters that are most useful in distinguishing the seeds of these three species and A. cristatum together with two of its strains.

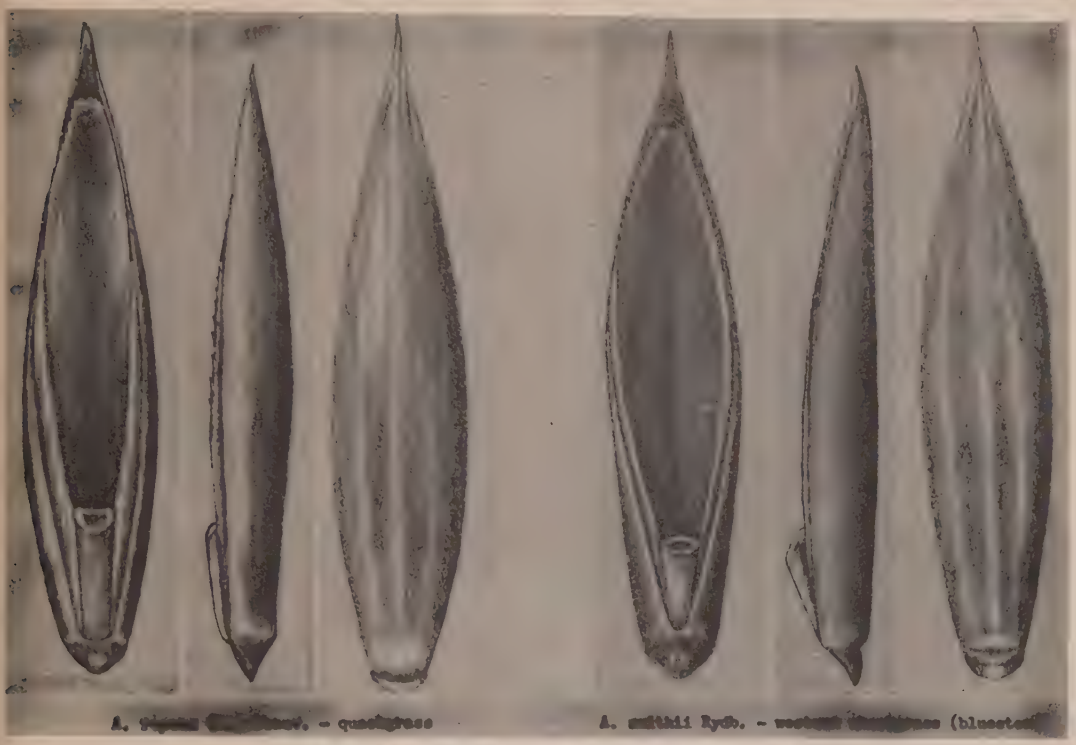
It is obvious that no one character of Agropyron seeds can be considered conclusive in determining the species, this being particularly true of the similar appearing seeds of A. repens, A. smithii, and A. trachycaulum. Consideration must be given to a composite of characters the most important of which are form, color, texture, shape of palea tip, concavity of the palea, shape and character of the rachilla, and the width of the opening between the edges of the lemma at the base of the rachilla. The pubescence on the surface of the palea and the hairs on the keels (Pl. 3, Fig. 1), and the position of the hairs on the callus (Pl. 1) are also helpful in making an identification, but in poorly developed or immature seeds these characters may not be clearly defined.

Of the four species considered, seed of A. cristatum (Pl. 2) is readily recognized because of its distinctive shape and other structural features. Plate 2, Fig. 1 shows seeds of what is popularly known as the standard form. In most commercial seed samples a few seeds will be found with hairy lemmas, as shown in Fig. 1. It is not known at the present time if this is a variant of the smooth seeded form or another species. The problem is receiving consideration. The Fairway strain of A. cristatum (Pl. 2, Fig. 2) has seed that is smaller and finer than that of the standard form, and the awn is longer in proportion to the length of the lemma. (See also Pl. 3, Fig. 1, E.) Plate 2, Fig. 3 shows seeds of a strain that differs from the standard by its rhizomatous habit of growth. The seed of this

m

1. The term seed is used in the popular sense, the caryopsis with its lemma and palea.
2. (A. tenerum Vasey; A. pauciflorum (Schwein.) Hitchc.)
3. On Pl. 2 the authority is erroneously given as (L.) Beauv.
4. Hillman, F. H. The distinguishing characters of the seeds of quackgrass and of certain wheatgrasses. U. S. Dept. Agr., Bur. Plant Indus. Cir. 73, 9 pp, illus. 1911.
   Dahlberg, R. C. Identification of the seeds of species of Agropyron. Jour. Agr. Res. 3:275-282, illus. 1914.
   Henry, Helen H. The seeds of quackgrass and certain wheatgrasses compared. Jour. Agr. Res. 35:537-546, illus. 1927.
5. Drawings on Pl. 2 and 3 by Regina Olson Hughes, Division of Forage Crops and Diseases; Pl. 1 and 4 by Helen H. Henry, The seeds of quckgrass and certain wheatgrasses compared.

PLATE 1 - Ventral, lateral and dorsal views of seeds of three similar appearing species of Agropyron. X 7 1/2



A. [illegible] - quackgrass

A. smithii Rydb. - western [illegible] (bluestem)

A. trachycaulum (Link) Malte - slender wheatgrass (A. tenerum) (A. pauciflorum)

may be distinguished from that of the standard, and of other species of Agropyron, by the densely pilose lemma and the character of the hairs on the keels of the palea (Pl. 3, Fig. 1, F). Investigations are now in progress to determine if this is in fact a strain of A. cristatum or a distinct species.

Superficially, the seeds of A. repens, A. smithii, and A. trachycaulum (Pl. 1) are very similar in appearance. They can be distinguished only by careful examination with a magnifier. However, it is not always possible to determine with certainty occasional seeds that are immature, poorly developed, or developed from terminal florets. Seeds of certain species of Elymus may appear similar to these three species of Agropyron and this fact should be borne in mind when making a determination.

The ease with which the individual seeds of A. repens, A. smithii, and A. trachycaulum may be distinguished depends to some degree on the position of the seed in the spikelet. This becomes evident on comparing the basal portions of seeds from the base, the middle and the upper parts of the spikelet as shown on Pl. 4. In the lowest floret in the spikelet the rachilla is often so short that scarcely more than the top of the segment is visible. This is less apparent in A. repens because the edges of the lemma do not overlap the sides of the rachilla at the base as in A. smithii and A. trachycaulum. Although the rachilla in the basal florets of all three species is usually shorter than in seeds from the upper part of the spikelet the typical diagnostic characters are readily recognized. Because of the persistent adherence to the stem of the spikelet the basal florets in A. repens and A. smithii often appear torn at the callus instead of disarticulating smoothly as in the upper florets. Seeds developed from terminal florets sometimes have elongated, strap-like rachillas. Such seeds are difficult to distinguish unless other typical characters are present.

Free grains of Agropyron sometimes occur incidentally with crop seeds. The grains of A. repens, A. smithii, and A. trachycaulum are very similar, and there is no way known to the writer whereby they can be distinguished. In general they are light brown, oblong, broadly concave on the ventral side, dorsal side convex with a distinct longitudinal groove on each side. The grains of A. cristatum are somewhat wedge-shaped, deeply grooved on the ventral side, the dorsal side sharply convex or keeled, with a longitudinal groove on each side.

Frequently the entire spikelets occur with crop seeds and a knowledge of the specific differences in the glumes enables one to identify the seeds within the spikelet (Pl. 3, Fig. 2). Mature spikelets of A. trachycaulum, and usually of A. smithii, tend to break apart readily, the basal seeds separating from the glumes, so that only occasional complete spikelets will be found in seed samples. The free glumes when present often remain united. Mature spikelets of A. repens tend to retain the seeds, and whole or partial spikelets in a sample are not uncommon.

For convenient reference the following tabulation gives a summary of the distinguishing characters most generally evident in the seeds of these four species of Agropyron.

PLATE 2 - Agropyron cristatum (L.) Beauv., crested wheatgrass

DIAGNOSTIC CHARACTERS OF SEEDS OF FOUR SPECIES OF AGROPYRON

A. REPENS	A. SMITHII	A. TRACHYCAULUM	A. CRISTATUM (Standard)
FORM			
Narrowly elliptical, thick, flattened dorso-ventrally (Pl. 1).	Narrowly elliptical, thick, not definitely flattened dorso-ventrally at the callus as in A. repens (Pl. 1).	Narrowly elliptical, greatest width just above the middle, many seeds not symmetrical in outline, seeds thin and flat (Pl. 1).	Lance-shaped, greatest width near base, thick, compressed laterally (Pl. 2).
LEMMA			
Light straw color with a greenish or brownish tinge; thick and lustrous; acute-pointed or terminating in a short awn; glabrous or sparingly scabrous at apex (Pl. 1).	Light straw color or brownish; thin, somewhat granular, sometimes slightly lustrous, the dark grain often shows through; acute pointed or terminating in a short awn; glabrous or sparingly scabrous on veins at apex (Pl. 1).	Light straw color, seldom greenish as in A. repens; thin and polished; acute pointed or terminating in a short awn; glabrous or sparingly scabrous at apex (Pl. 1).	Light straw color, or with brownish tinge; thick and lustrous; acute pointed or terminating in a stout awn; glabrous or sparingly scabrous at apex, occasionally sparingly pilose (Pl. 2).
Edges of lemma not overlapping sides of rachilla at the base so that sinus appears U-shaped (Pl. 4, Fig. 1); except in basal seeds, edges of lemma do not extend to keels of palea in well developed seeds (Pl. 1).	Edges of lemma overlap sides of rachilla at the base, producing V-shaped sinus (Pl. 4, Fig. 2); lemma generally extends to keels of palea (Pl. 1).	Edges of lemma overlap sides of rachilla at the base, sinus V-shaped (Pl. 4, Fig. 3); lemma generally extends to keels of palea (Pl. 1).	Edges of lemma not overlapping sides of rachilla at the base, sinus appears U-shaped (Pl. 2); edges of lemma do not extend to keels of palea (Pl. 2).
Pronounced bulge at base of lemma just above callus; lemma not indented below bulge (Pl. 1).	Bulge less pronounced than in A. repens; usually sharply indented or broken below bulge (Pl. 1).	Bulge less pronounced than in A. repens; only occasionally indented below bulge (Pl. 1).	Prominent bulge at base of lemma just above callus: usually sharply indented below bulge (Pl. 2).
CALLUS			
Entirely smooth, or occasionally with a few short hairs at edges of lemma (Pl. 1).	Middle portion smooth with short hairs at either end (Pl. 1).	Hairs across entire callus, rarely as in A. smithii (Pl. 1).	Callus entirely smooth (Pl. 2).
SCAR AT BASE			
Suture broadly triangular, smooth, or rough in some basal seeds (Pl. 1; Pl. 4, Fig. 1).	Suture broadly triangular, smooth, or rough in some basal seeds (Pl. 1; Pl. 4, Fig. 2).	Suture small, smooth, narrowly triangular, sharply pointed at the base (Pl. 1; Pl. 4, Fig. 3).	Suture broadly triangular, smooth (Pl. 2).

A. REPENS	A. SMITHII	A. TRACHYCAULUM	A. CRISTATUM (Standard)
PALEA			
Broadly concave throughout entire length, not flattened out at tip (Pl. 1); hairs on keels short and blunt; surface glabrous, or finely hirsute at the tip and granular below; apex truncate or indented, sometimes obtuse or rounded (Pl. 3, Fig. 1, A).	Deeply concave, sometimes grooved below the middle, not flattened out at the tip (Pl. 1); hairs on keels coarse, longer than in A. repens; entire surface usually hirsute; apex rather deeply cleft (Pl. 3, Fig. 1, B).	Concavity shallow, tends to flatten out at the tip (Pl. 1); hairs on keels fine, acute pointed, close together; surface hirsute at tip, glabrous below; apex narrowly truncate, rounded or indented (Pl. 3, Fig. 1, C).	The inturned keels almost touch at the middle, then tend to spread apart toward the tip (Pl. 2); hairs on keels coarse, blunt, wide spaced; surface minutely hirsute; apex uniformly deep-cleft (Pl. 3, Fig. 1, D).
RACHILLA			
Glabrous or sparingly hirsute; the sides parallel, or only slightly divergent in basal seeds; the segment flattened against the palea, either within the inturned keels or against them (Pl. 1; Pl. 4, Fig. 1).	Usually hirsute; hairs more numerous and longer than in A. repens; except in terminal seeds, sides diverge noticeably, the lines often curving out at upper end; not appressed to palea (Pl. 1; Pl. 4, Fig. 2).	Pilose; the sides slightly divergent, except in terminal seeds; not appressed to palea (Pl. 1; Pl. 4, Fig. 3).	Hirsute; sides divergent toward the top; not appressed to palea (Pl. 2).
GLUMES			
Widest point about middle or above, narrow abruptly to the awned apex; keeled. Awn and upper part of midvein usually scabrous.	Often narrower than in A. repens, taper gradually to the awned apex; keeled. Awn and upper part of margins and midvein scabrous.	Taper gradually to the awned apex; not keeled. Awn and midvein scabrous, sometimes smooth.	Narrow abruptly to the awned apex; keeled. Awn and upper midvein sparingly scabrous.
Wide hyaline margins on upper half of glumes.	Wide hyaline margins on lower half of glumes.	Entire margins hyaline, widest point about middle.	Entire margins hyaline, widest point about middle
Veins 5-7, thick and cordlike, the midvein usually coarser (Pl. 3, Fig. 2, A).	Veins 3-5, obscure, or if distinct not prominent as in A. repens (Pl. 3, Fig. 2, B).	Veins 5-7, slender, distinct, often appearing as fine ridges (Pl. 3, Fig. 2, D.)	Veins 3-5, faint or obscure (Pl. 3, Fig. 2, C).

PLATE 3 - Distinguishing characters of the paleas and spikelets of four species of Agropyron

Fig. 1. - Paleas showing characteristic tips, pubescence and marginal hairs. A, Agropyron repens; B, A. smithii; C, A. trachycaulum; D, A. cristatum (standard); E, A. cristatum (fairway strain); F, A. cristatum (rhizomatous strain). X 7 1/2

Fig. 2. - The form of spikelet (X7 1/2) and distinguishing features of the glumes. A, A. repens; B, A. smithii; C, A. cristatum (standard); D, A. trachycaulum

PLATE 4 - Basal portions of seeds of Agropyron repens, A. smithii, A. trachycaulum, showing types of rachillas and their position in relation to the lemma

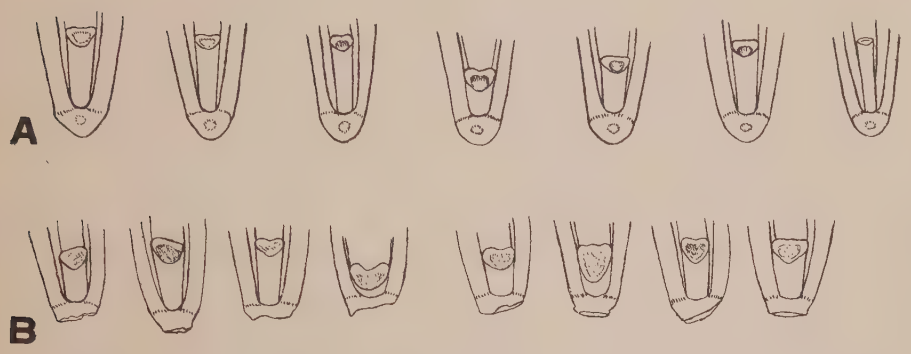


Figure 1. - A. repens. A, seeds from middle and upper part of spikelet; B, basal seeds

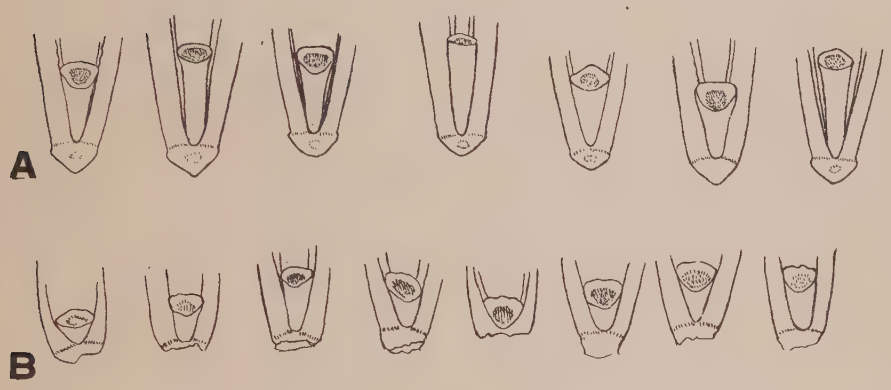


Figure 2. - A. smithii. A, seeds from middle and upper part of spikelet; B, basal seeds

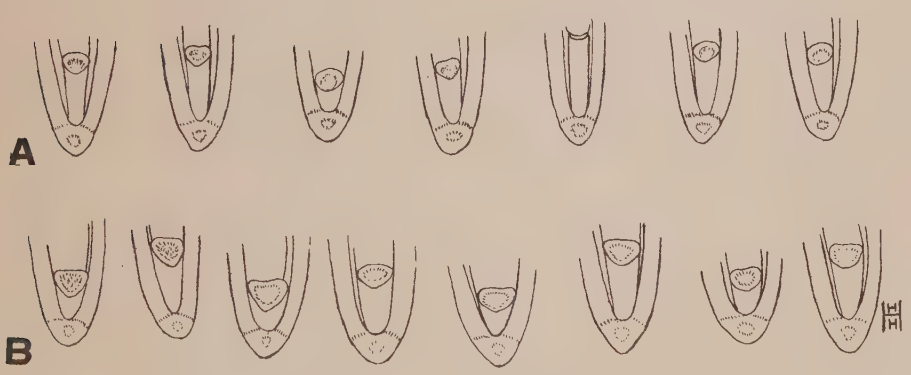


Figure 3. - A. trachycaulum. A, seeds from middle and upper part of spikelet; B, basal seeds

SEEDS OF COMMERCIAL SPECIES OF BRASSICA

By

Albina F. Musil, Assistant Botanist[1]
Division of Forage Crops and Diseases
UNITED STATES DEPARTMENT OF AGRICULTURE
Bureau of Plant Industry
Washington, D. C.

Seeds of Brassica appear so much alike that in order to distinguish the species it is necessary to study the seeds under magnification until the structural characters are recognized and assume differentiating value. It is possible to distinguish bulk samples in most of the species, but the individual seeds cannot always be determined with certainty. It is usually possible, however, to make a reliable separation of a mixture. The accuracy of the test will necessarily depend on the proficiency of the individual worker.

Until sufficient experience has been gained to recognize seeds of the different kinds individually as well as in bulk, or if the identity of the sample is doubtful, it is advisable to verify the laboratory test by a greenhouse test. The distinguishing characters of the seedlings are described in a previous paper, United States Department of Agriculture mimeograph, "The identification of Brassicas from seedling growth."

Because of the similarity apparent in the seeds of some of the species it is important that only authentic seed samples be used for study and reference. Whenever possible the most satisfactory way to build up such a reference set is to verify each sample by a growing test. With the possible exception of charlock and some of the yellow-seeded kinds no one sample can be considered wholly representative of the species. Bird rape (B. campestris) in particular has various types of seed. A certain amount of variability can be expected in most of the kinds and a reference set should contain a series of samples to show as wide a range as possible.

Seeds of Brassica may be broadly oblong, spherical, or slightly flattened laterally so that they appear oval or roughly triangular in outline. The surface is roughened by a network of lines or ridges of irregular pattern and varying in size of interspaces. In the interspaces and sometimes on the ridges are minute pits. In certain species particles of a whitish or yellowish epidermal membrane persist in these pits so that in reflected light they appear as glistening white stipples. On one side of the seed may be seen a depression with a distinct longitudinal ridge in the middle. This ridge is the outline of the radicle (root) of the embryo. The seed scar appears as a more or less indefinite spot on the surface near the tip of the radicle. Near one end of the scar is a short raised line, the chalaza.

The seeds in the bulk sample will be either light colored (pale straw color or yellow) or dark (grayish black to various shades of reddish brown). The dark colored samples may have seed that is uniform in color or it may be a mixture, sometimes to the extent of giving the entire bulk a reddish aspect. The kinds with light colored seeds now in commercial use are readily distinguished so the main study will be concentrated on the dark colored kinds.

When making a determination the first consideration is the size of the seed. The size of individual seeds in a sample may vary considerably but the bulk of the seed will appear either relatively large (2-3 mm in length) or small (less than 2 mm). This will place the seed into one of two general groups, the winter rape-cabbage group or the mustard group. The next consideration is the type of reticulation, the relative size of the interspaces, and the character of the stippling. Color is helpful to some degree, but except in the light seeded kinds it may be too variable to be conclusive.

The scar does not appear to have any reliable diagnostic value. It may be more or less obscure or vary in character in seeds from the same sample or of different lots of the same species. For purposes of illustration seeds were selected that show the scar detail clearly but as a rule it is not so clearly defined in all seeds of a sample. The chalaza and the depression on the side of the seed and the grooves on either side of the radicle ridge are also too variable to be considered distinguishing features.

The magnification to be used for the study of these seeds will depend to some extent on individual preference, but it should be sufficiently large to show the necessary detail clearly. It is often helpful to examine the sample first under low magnification for the gross characters, then to use the higher magnification for the finer distinctions. Charlock can usually be distinguished in a mixture more readily under low magnification than under a higher power. The descriptions that follow are based on observations made under a binocular microscope at a magnification of 40.

The illustrations show the seeds magnified 8X and 1 1/5X. The greatly enlarged surface detail is not drawn to scale but a relative proportion has been maintained throughout. This detail shows the character of the stippling in relation to the reticulations as most commonly found in the species represented. The detail at the lower left in certain figures shows the character of the interspaces, the relative depth and shape (cup-shaped or flat).

KEY TO BULK DISTINCTIONS

1a. Seeds pale straw color or yellow

Seeds small, reticulated

Reticulations and stipples distinct .....(7) *B. juncea*

Reticulations faintly evident, sometimes lacking, stipples distinct.....(17) *B. campestris* var. *sarson*

Seeds large, not evidently reticulated

Surface rugose, stipples not evident.....(6) *B. hirta*

1b. Seeds grayish black, dull brown, or reddish

2a. Seeds large, 2-3 mm.

Reticulations thin and flat; interspaces large; stipples small, dull; seed spherical.....(1) *B. napus*

Reticulations more pronounced than in (1) and interspaces slightly smaller; stipples small, shiny; seed spherical or slightly flattened.....(2) *B. napus* var. *oleifera*

SEEDS OF COMMERCIAL SPECIES OF BRASSICA

Seeds enlarged 4½ and 1 [illegible] The greatly enlarged scale is totally out from to scale but the relative proportion has been maintained throughout the entire series

B. napus L. Winter rape
B. napus var. oleifera DC. Summer rape
Brassica sp. Dwarf Siberian kale
B. napobrassica Mill. Rutabaga
B. oleracea var. capitata L. Cabbage
B. hirta Moench. White mustard
B. juncea (L.) Coss. Indian mustard
B. nigra (L.) Koch. Black mustard
B. rapa L. Turnip
B. rapa var. oleifera DC. Turnip rape
B. campestris L. Argentine bird rape
B. campestris L. Bird rape (West coast form)
B. perviridis Bailey Spinach mustard
B. pekinensis (Lour.) Rupr. Petsai
B. chinensis L. Pakchoi
B. amber (DC.) Shuttleworth Chartsai

Reticulations and interspaces as in (2), sometimes as in (1); stipples small, shiny; seed spherical or slightly flattened. (3) B. sp., Siberian kale

Reticulations coarse; interspaces large; stipples large, shiny; seed slightly flattened or spherical. ..... (4) B. napobrassica

Reticulations coarse; interspaces small; reticulations and fine, shiny stipples partially obscured by a waxy coating; seed variously compressed, rarely spherical..... (5) B. oleracea

2b. Seeds small, less than 2 mm (some exceptions in Nos. 7 and 9)

Surface smooth and velvety or with obscure reticulations; stipples faintly evident or lacking; seed spherical. (16) B. kaber

Reticulations thick, cordlike; interspaces large; stipples fine, usually obscured by a mucilaginous layer; seed oblong. (8) B. nigra

Reticulations fine distinct lines; interspaces large; stipples small, dull or shiny; seed spherical. .....(7) B. juncea

Reticulations prominent; interspaces small; stipples small, distinct, shiny; seed spherical or slightly flattened...(9) (10) B. rapa, (13) B. perviridis, (15) B. chinensis.

Reticulations as in (9), or only slightly evident, sometimes lacking; stipples as in (9); seed slightly flattened or spherical..(11) (12) B. campestris

Reticulations coarser than in (9) or indistinct; interspaces and stipples larger than in (9); stipples shiny, rectangular; seed slightly flattened, some spherical, usually larger than (9)..... (14) B. pekinensis

DESCRIPTION OF SEEDS

(1) B. napus L., winter rape. Color grayish black or with a varying proportion of the bulk reddish; seeds uniformly spherical in well-developed lots; reticulations thin and flat, sometimes indistinct, the general effect being of fine whitish lines superimposed on the surface rather than a definite part of the seed coat; interspaces large; stipples dull, small in proportion to size of seed, mostly wide-spaced and spherical in shape as illustrated, or if rectangular some of the stipples may be shiny.

(2) B. napus var. oleifera DC., summer rape. Color as in (1); not so uniformly spherical, many seeds slightly flattened laterally; reticulations more pronounced than in (1), appear as fine ridges rather than lines, stipples often evident on the ridges, occasional seeds with very coarse reticulations; interspaces mostly smaller than in (1); stipples small, rectangular in shape, shiny, occasionally spherical and dull. Most seeds lack the smooth, clean cut appearance of (1).

(3) B. sp., dwarf Siberian kale. Color as in (1); seeds spherical or slightly flattened; reticulations and interspaces as in (2), sometimes as (1); stipples as in (2). In general the seeds have more of the smooth appearance of (1) rather than the slightly rougher surface of (2); not always distinguishable from (1) and (2). Some lots have considerable small seed (less than 2 mm).

(4) B. napobrassica Mill., rutabaga. Color grayish black, often with adhering patches of bronze colored epidermal tissue; not uniformly spherical as in (1), many seeds slightly flattened laterally or angular in outline; reticulations coarser than in (2) or (3), with stipples cleanly evident on the ridges; interspaces large; stipples rectangular in shape, large, shiny, occasionally roundish and dull as in (1).

(5) B. oleracea var. capitata L., cabbage. Grayish brown or bronze colored, occasional seed reddish, with a grayish translucent epidermal tissue adhering in spots; seeds varicusly compressed, often triangular in outline, only rarely spherical; reticulations fairly coarse; interspaces small; stipples fine, shiny; both reticulations and stipples partially obscured by the epidermal tissue so that the surface appears waxy and finely rugose rather than distinctly reticulated.

The B. oleracea group includes several botanical varieties other than cabbage:

B. oleracea var. botrytis L., cauliflower and broccoli
B. oleracea var. gongylodes L., kohlrabi
B. oleracea var. gemmifera Zenker, Brussels sprouts
B. oleracea var. acephala DC., collards and kales

The seeds of these varieties exhibit the specific features of B. oleracea as described under (5), but the variety cannot always be distinguished. The common kitchen kales can often be distinguished from the rest of the B. oleracea group. Compared with cabbage the seeds are usually smaller and smoother. The irregularity in shape is less pronounced, the tendency is to be more spherical or slightly flattened laterally. The small, usually shiny stipples are more distinct than in cabbage. Some authorities refer this group of plants to B. fimbriata DC. Until a more extensive study is made of the seed it might be less confusing to leave the group under B. oleracea.

The seed of dwarf Siberian kale shows no relationship to B. oleracea. For this reason it is put as an undetermined species with the winter rape group which it resembles so closely that it is not always possible to distinguish them. (See No. 3.)

The various field kales, the best known of which is thousand-headed kale, all show the definite B. oleracea characters as represented by cabbage (5). One of the smooth kales known as Hanover salad is of doubtful identity. None of the seed so far examined has been of the B. oleracea type. Some of the lots have been winter rape and rutabaga.

(6) B. hirta Moench (B. alba), white mustard (white London mustard, yellow mustard). Pale straw color with a pinkish cast, occasional seeds light brown; mostly flattened laterally, sometimes spherical; surface rugose, not evidently reticulated or stippled. Through the translucent epidermal layer may be seen the outlines of reticulations, with very small interspaces, producing the roughened effect. (Compare with No. 17.)

(7) B. juncea (L.) Cosson, India mustard (brown mustard). There are two kinds of India mustard on the market, (a) seeds reddish brown to dark brown, or grayish black, (b) seeds light yellow, with usually a few of the brown seeds present. In the latter group belongs the domestic seed known as Oriental mustard. Seeds of both kinds are mostly spherical; reticulations appear like distinct, clear cut lines superimposed on the surface; interspaces large, only occasionally cup-shaped as in (8); stipples fine, shiny or dull.

In the dark-seeded group belong the various horticultural varieties known as leaf mustards. They appear in the trade under various names such as Southern giant curled mustard, ostrich plume, Fordhook fancy. The seeds of the leaf mustards are often smaller and darker in color than the field types.

Seeds of certain varieties that have been imported from India are as large as winter rape, and dusty reddish brown in color. Apparently this type has never been grown in this country.

(8) B. nigra (L.) Koch, black mustard (Trieste mustard). Usually smaller in size than (7); reddish brown; predominant shape broadly oblong, sometimes slightly flattened; reticulations thick and cord-like, giving the effect of the seed surface drawn up into a network of distinct ridges; interspaces somewhat smaller than in (7), mostly cup-shaped, the surface glossed over with a mucilaginous layer so the stipples are not evident or only partially so; stipples when evident appear finer than in (7).

(9), (10), (11), (12) The turnip-bird rape group (B. rapa-B. campestris). The seeds in this group are so similar that some lots cannot be positively identified and an examination of the seedlings is necessary. There are, however, certain general distinctions that with experience may be recognized and a reliable determination made in many cases.

(9) B. rapa L., turnip. Seeds small, or larger (2 mm) in the Shogoin or Japanese turnips; color mostly reddish brown, some lots predominantly reddish, others grayish black; most seeds lightly flattened laterally; reticulations prominent, with small interspaces, so that the surface has a puckered appearance; some seeds with very coarse reticulations and large interspaces; stipples sharply distinct, small, roundish, shiny.

There are many horticultural varieties of turnip, and no attempt is made to distinguish them from seed. Here belong also the strap-leaved races and the foliage turnips, the seeds of which are doubtfully distinct from the common garden turnip. The foliage turnips are usually designated as seven-top turnip or turnip-top broccoli. The term broccoli rape as used by the trade may include also various mustard greens, rape, and common turnip tops. In some sections small turnip plants are marketed for greens under the name rappini (small turnip).

(10) B. rapa var. oleifera DC., turnip rape. Seed in general as in (9), but appears more roughened, not as smooth and clear cut. Color is predominantly reddish, and samples run fairly uniform in size.

(11) B. campestris L., Argentine bird-rape. Seeds small, grayish black, sometimes reddish; spherical or slightly flattened laterally; reticulations usually coarser than in (9), even those seeds with lighter reticulations appear more distinctly roughened, and a larger proportion of the seeds have the very coarse reticulations; interspaces small, except in some of the very coarsely reticulated seeds; stipples as in (9) or possibly a little larger; the bulk lacks the smooth, clean-cut appearance of (9).

(12) B. campestris L., bird rape of the Pacific coast (wild turnip). Well developed seed mostly spherical, sometimes slightly flattened laterally; grayish black to reddish brown; reticulations and stipples as in (11). In many seeds the interspaces are not so deeply cup-shaped as in (11).

Seed of B. campestris L., bird rape, from European and Asiatic sources

(not illustrated) is variable. In general, it lacks the spherical, grayish black seed common to (11) and (12), and is often larger in size. The seed is predominantly reddish, from India often a grayish, dusty color; flattened and sometimes angular in outline; reticulations may be coarse or almost lacking; interspaces correspondingly larger than in the smaller seed of (11) and (12). A light-seeded variety has been imported from India. (See No. 17).

(13), (14), (15) Oriental vegetables. In these three species the distinctions are difficult to illustrate or describe, but as with the turnip-bird rape group it is possible with practice to recognize bulk distinctions. When necessary to verify the seed identification the seedlings may be distinguished at a very early stage.

(13) B. perviridis Bailey, spinach mustard (tendergreen). Seeds small, grayish black, some dull reddish brown; slightly flattened laterally, occasional seed spherical; reticulations fine, only rarely lacking, interspaces small, a few seeds with coarser reticulations and larger interspaces, but these are never so coarse or of such frequent occurrence as in turnip (9); stipples small, roundish, shiny, but not generally so prominent as in the turnip group.

(14) B. pekinensis (Lour.) Rupr., petsai (Chinese cabbage, celery cabbage). Seeds slightly larger than (13); reddish brown, a few seeds grayish black; slightly flattened laterally, some seeds spherical; reticulations coarser and interspaces larger than in (13), a few seeds with very coarse reticulations, some with no evident reticulations; stipples shiny, slightly larger than in (13) and more rectangular in shape. Compare with (3) and (4) which have similarly shaped stipples.

There are several horticultural varieties in the market under such names as Wong Bok, Chihili, and Cheefoo. No attempt is made to distinguish them from seed.

(15) B. chinensis L., pakchoi (Chinese white mustard, white celery mustard). Size about as in (13); reddish brown to dusty grayish black; mostly spherical, sometimes slightly flattened laterally; reticulations more prominent and clearly defined than in (13) and (14); interspaces usually small, only occasionally large; stipples shiny, distinct, roundish, seldom rectangular as in (14). Chief distinctions from (13) are the plump, spherical shape and the more clearly defined surface markings.

The seed of a very similar plant known as mock pakchoi (B. parachinensis) is sometimes in the market. The seeds of the two are doubtfully distinct.

(16) B. kaber (DC.) Wheeler, (B. arvensis), charlock. Seeds spherical, dull black or reddish; under low magnification the smooth, velvety surface stands out conspicuously in a mixture of kinds; under higher magnification the surface is faintly roughened with thick, flat reticulations, with small interspaces, the entire surface finely stippled; the reticulations and stipples more or less obscured by a mucilaginous epidermal layer which gives it the smooth, velvety appearance.

(17) B. campestris var. sarson Prain, sarson. Not illustrated. Seeds large; pale straw color with a pinkish cast, usually a few seeds of the brown-seeded variety present; mostly flattened laterally; reticulations indistinct, or sometimes lacking; interspaces large; stipples fine, distinct, shiny. (Compare with No. 6.)

DIAGNOSTIC CHARACTERS OF SEED OF THE COMMERCIAL SPECIES OF AGROSTIS AND CERTAIN SPECIES OCCURRING INCIDENTALLY WITH THEM[1]

by

Albina F. Musil, Assistant Botanist,
Division of Forage Crops and Diseases

UNITED STATES DEPARTMENT OF AGRICULTURE

Bureau of Plant Industry

Washington, D. C.

The accompanying illustrations are an attempt to show the range of seed characters that may be found within a species. The seeds (fruits) illustrated[2] were taken from authentic plants. In many cases it was possible to find the complete range on a single panicle. The drawings are shown magnified 25 X. The ventral views show the relative length and character of the paleas. Only those seeds showing well exposed paleas could be used for this purpose and consequently they do not represent the type most commonly found in some seed lots. The variations in palea tips are shown in Plate 9. Because of the difficulty of removing the entire palea intact, these drawings do not represent accurate measurements.

It will be observed that rachilla segments vary from long and hairy to mere prickles. In the material examined none were observed in A. palustris, creeping bent. It is possible that they also occur in this species, but infrequently. They appear most frequently in highland bent.

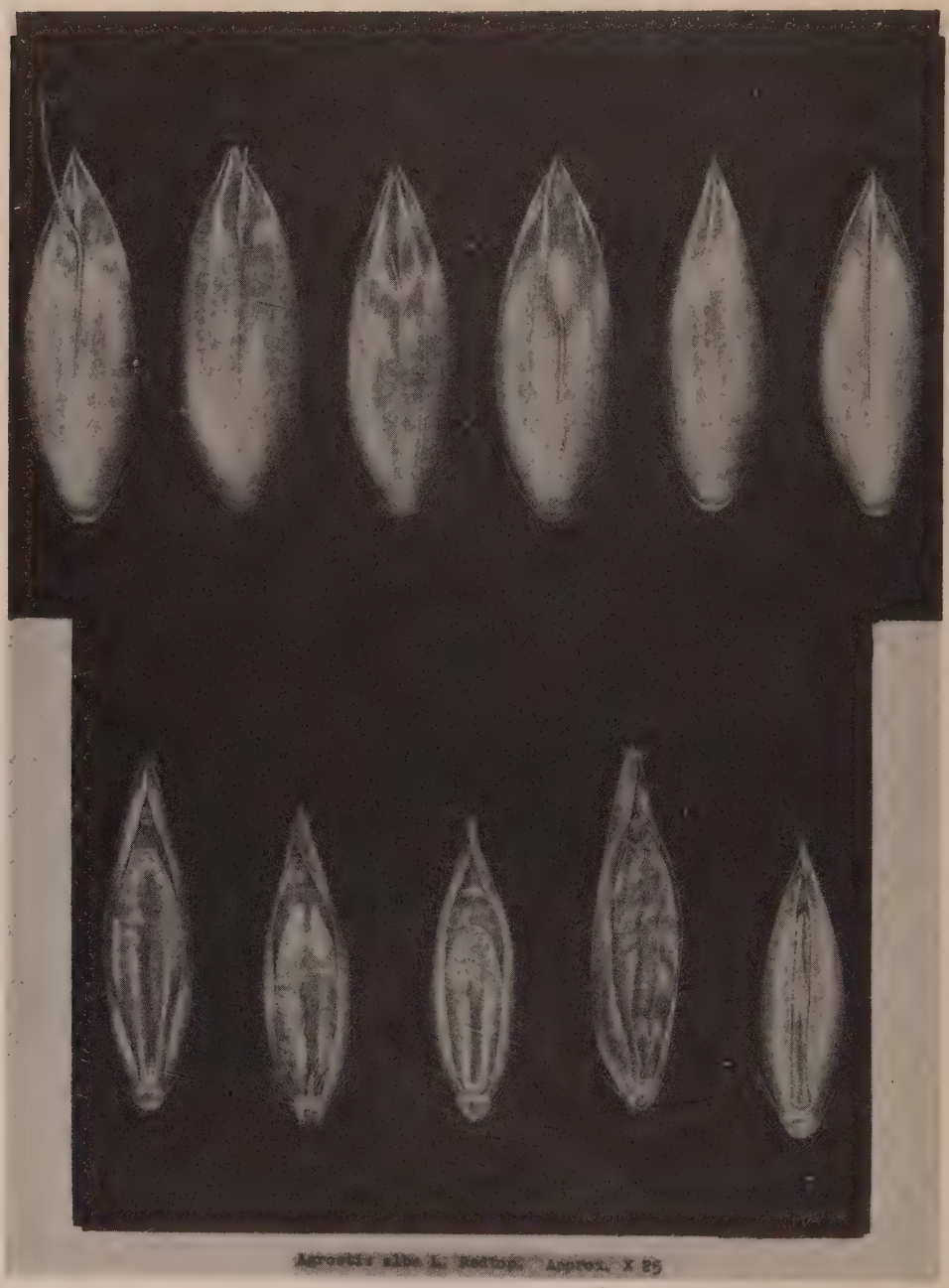
In the descriptive key here presented, A. semiverticillata is not included. The character of the seed suggests a closer relationship to Polypogon than to Agrostis, and further investigation may require a different disposition of it. Since both A. semiverticillata and Polypogon monspeliensis may occur incidentally in bentgrass from the Northwest they are included in this study. The awn of P. monspeliensis is so frail it would rarely if ever persist in a seed sample. In the absence of the awn the seeds of the two grasses are very similar. The main distinction appears to be in the narrower base and the short, pointed callus of Polypogon as shown in Plate 8.

A. exarata, spike redtop, is reported to be a very variable plant, and its various forms are not clearly defined. No attempt is made to separate them on seed characters until further investigation can be made. The whole group is here considered as A. exarata.

The seed descriptions that follow are based on observations made at a magnification of 40 X.

1. The illustrations and part of the descriptive matter here presented are from a manuscript now being prepared for publication under the above title.
2. The drawings illustrating the seeds were made by Regina Olson Hughes, Division of Forage Crops and Diseases.

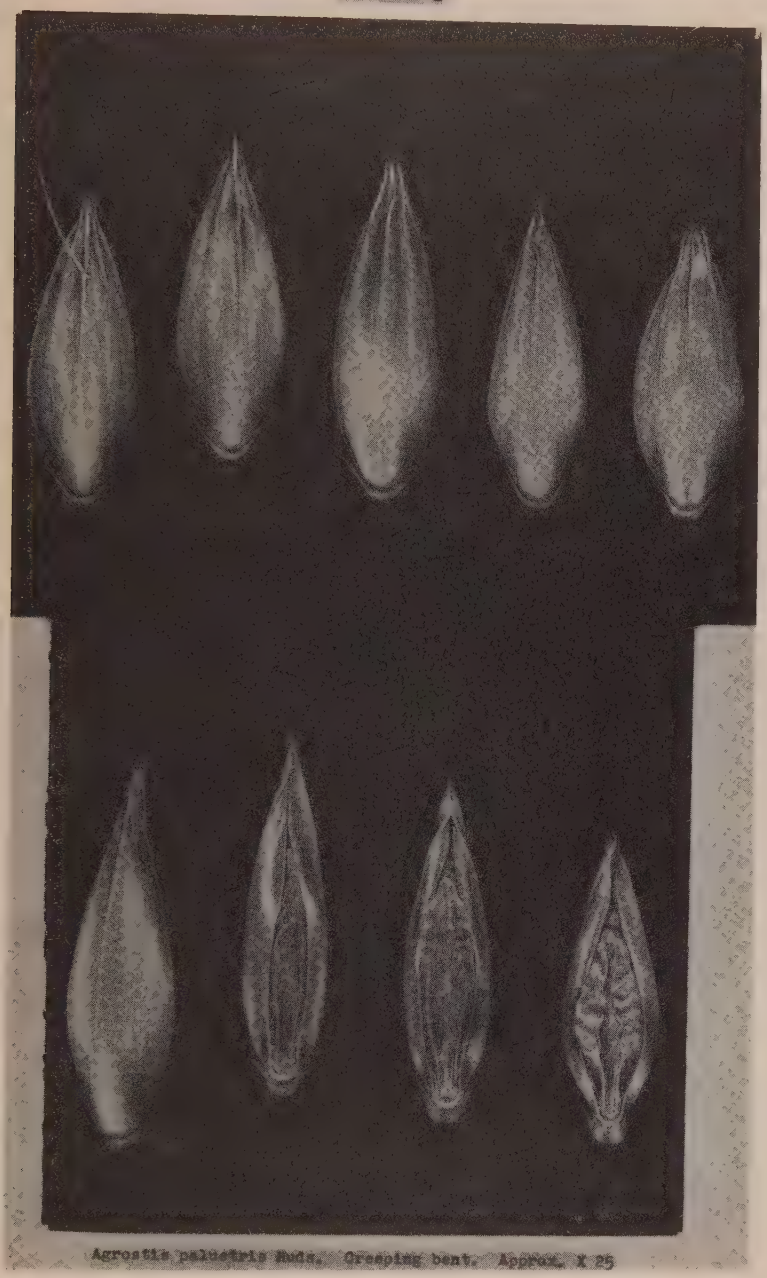
PLATE I



The Principal Regions of Production or Incidental Occurrence of the Species Under Consideration

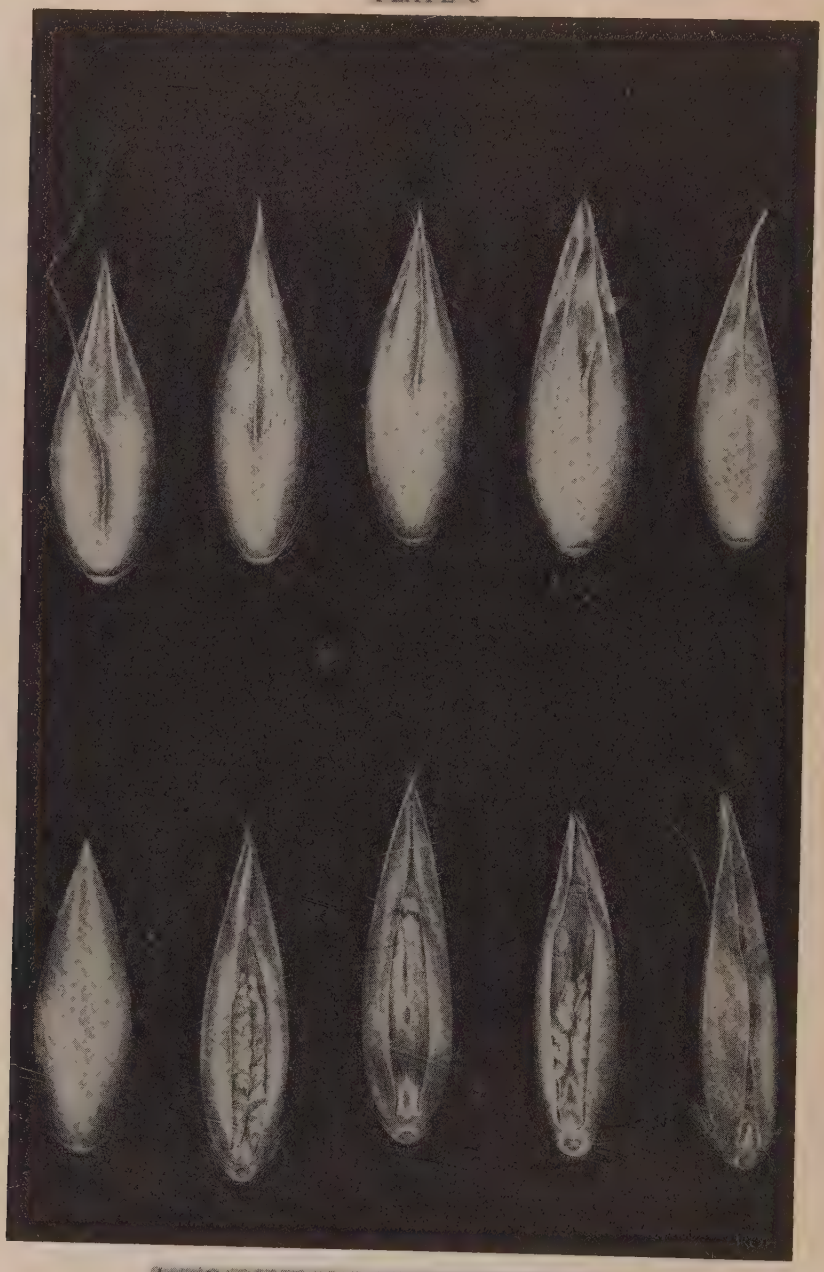
A. alba - Illinois; incidental in bentgrass from the Northwest.
A. tenuis, colonial bent- Rhode Island; Canada; New Zealand; west Central Europe.

PLATE 2



A. tenuis, Astoria bent - Washington; Oregon.
A. tenuis, highland bent - Oregon.
A. palustris - Oregon; Washington; Rhode Island; Connecticut; Canada; New Zealand.
A. canina - Rhode Island; Connecticut; Canada; west central Europe.
A. elliottiana - Incidental in A. alba, Illinois grown.

PLATE 3



Agrostis tenuis Sibth. Colonial bent. Approx. X 25

A. hiemalis - Incidental in A. alba, Illinois grown.
A. scabra - Incidental in seed samples from Oregon and Washington.
A. exarata - Incidental in bentgrass from Oregon and Washington.
A. semiverticillata (and the similar appearing seed of Polypogon monspeliensis) - Incidental in bentgrass from Oregon and Washington.

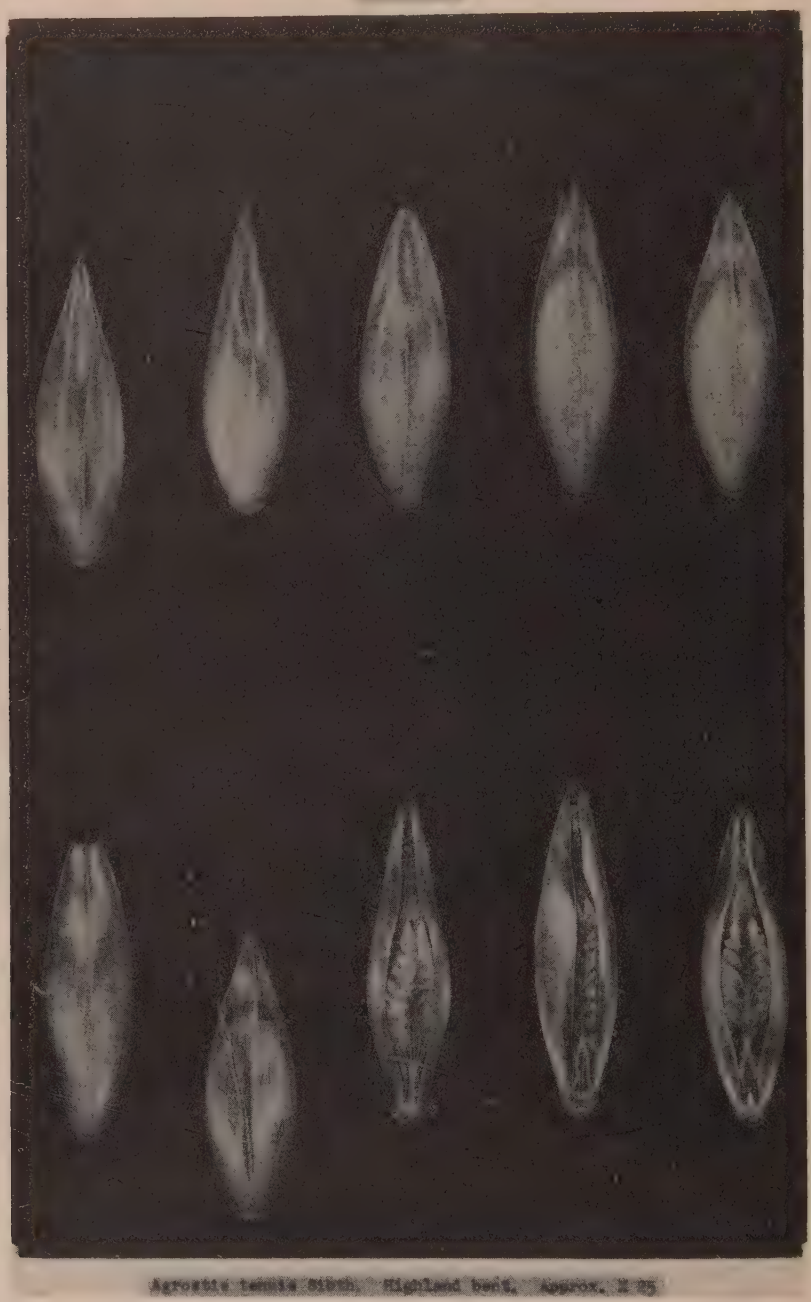
PLATE 4

Agrostis tenuis Sibth. Astoria bent. Approx. X 25

Bulk Distinctions of the Commercial Species

A. alba, redtop (Plate 1) - Seed in bulk appears large and plump; general shape oblong or elliptic; lemmas yellowish to straw-colored, thick and glossy as if varnished, smoothly rounded toward the base, apex predominantly 3-veined; awns, when present, short and straight, never twisted and geniculate; the coarsely notched or truncate tips of the paleas

PLATE 3



Agrostis tenuis Sibth. Highland bent. Approx. X 25

usually in evidence, some seeds with paleas longer and folded, the tips obscured by the edges of the lemma; callus thickened vertically, rounded.

A, palustris, creeping bent (Plate 2) - Seeds about the size of redtop; ovate to elliptic; lemmas vary from a slightly lustrous silvery gray to straw-color and glossy, the texture more delicate and papery than redtop, predominantly 5-veined at apex, usually with a distinct keel toward the

PLATE 6

A.-Agrostis canina L. Velvet bent. Approx. X 25

B.-Agrostis elliottiana Schult. Annual Ticklegrass. Approx. X 2

base and a prominent constriction above the thick angular callus; many seeds thickened at the middle producing a slightly humped appearance on the dorsal side; awns, when present, short and straight, never twisted and geniculate; paleas usually broad and loose from the grain.

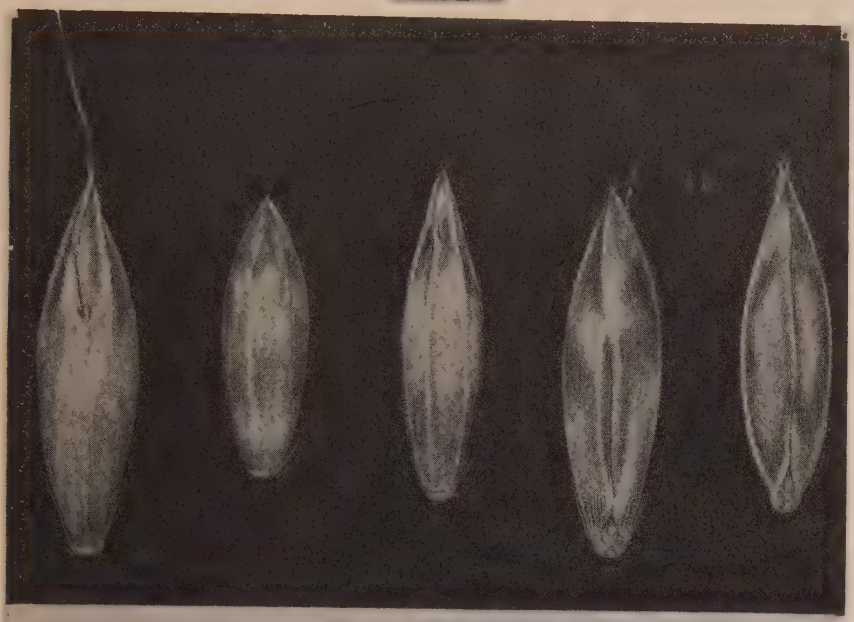
PLATE 7

A.-Agrostis hiemalis (Walt.) B.S.P. Ticklegrass. Approx. X 25

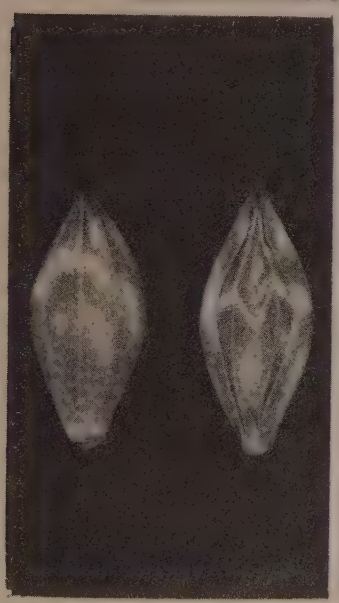
B.-Agrostis scabra Willd. Approx. X 25

A. tenuis, colonial bent (Plate 3) - The smallest of the commercial bents with the exception of A. canina; shape ovate-lanceolate; lemmas dull gray, porous and weathered looking, predominantly 3-veined at apex, rounded toward the base; callus very fine and rounded; awns frequent, stout, geniculate, twisted, arising from below the middle of lemma; paleas thin, wrinkled and adherent, about $\frac{1}{2}$ the length of the grain or shorter.

PLATE 8



A.-Agrostis exarata Trin. Spike redtop. Approx. X 25

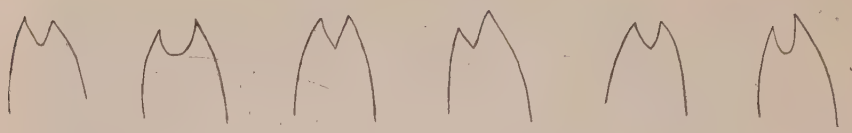


B.-Agrostis semiverticillata (Forsk) C. Christ
Water bent. Approx. X 25

C.-Polypogon monspeliensis (L.)Desf.
Rabbitfoot grass. Approx. X 25

A. tenuis, Astoria bent (Plate 4) - The bulk consists of a mixture of small seeds indistinguishable from colonial bent, and larger seeds that resemble redtop in size and shape (the larger seeds only are illustrated in Plate 4). The principal distinction from redtop is in the dull weathered appearance of the lemmas as compared with the thick, glossy lemmas of redtop.

Characteristic palet tips PLATE 9



A.-Agrostis tenuis Sibth. Highland bent

B.-Agrostis tenuis Sibth. Astoria bent

C.-Agrostis tenuis Sibth. Colonial bent

D.-Agrostis alba L. Redtop

E.-Agrostis palustris Huds. Creeping bent

In addition to the numerous seeds with heavy geniculate, twisted awns, samples of Astoria bent usually carry many seeds with short straight awns or merely awn prickles about midway or higher on the lemma.

A. tenuis, highland bent (Plate 5) - Seeds linear-oblong or spindle-shaped; lemmas somewhat lustrous, light gray to light straw-color, the apex predominantly truncate, occasionally pointed, 3-veined, the veins often

exserted at the apex; awns in some lots infrequent, when present they are twisted and geniculate, arising from below the middle of lemma or straight and shorter about midway or higher; basal hairs mostly lacking; paleas taper gradually from the base, terminating in a characteristic V-notch; callus medium thick. (Present evidence indicates that this plant does not belong in the A. tenuis group. It is left here for convenience until further investigation can be made.)

A. canina, velvet bent (Plate 6) - Seeds linear-oblong or narrowly elliptic; lemmas thin, dull gray, finely granular, often covering the entire grain; 3-veined at apex; awns frequent, either twisted and geniculate or straight and shorter, arising from about the middle of lemma; basal hairs few and short or lacking; paleas so minute they appear to be lacking; grains very soft.

The Identification of Individual Seeds
(The caryopsis with its lemma and palea)

A descriptive key

I - Palea from ½ to slightly exceeding the length of the caryopsis; caryopsis hard.

Awns infrequent, when present short and straight or reduced to a coarse prickle, arising about the middle of lemma or higher.

Lemma thick and glossy as if varnished, translucent, sometimes opaque; apex 3-veined (rarely 5), the midvein only occasionally faintly evident to base; back of lemma smoothly rounded, not keeled toward base, not evidently constricted above the callus; callus thickened vertically, rounded.

Shape oblong or elliptic.

Palea tapers gradually from the base; apex usually truncate or coarsely V-notched (Pl. 9).....A. alba (Pl. 1).

Lemma slightly lustrous, silvery (western-grown seed often straw-colored and glossy); translucent, sometimes opaque, more delicate and papery in texture than redtop; apex 5-veined, (rarely 3), the midvein usually evident to base; back of lemma distinctly keeled all the way or only toward base, prominently constricted above the callus; callus thickened vertically, somewhat angular.

Shape ovate or elliptic, sometimes narrowly oblong; dorsal side often sloping toward each end from the thickened middle.

Palea narrowed abruptly near the apex, producing a shoulder-like effect, variously notched (Pl. 9)...A. palustris (Pl. 2).

Awns frequent, coarse, twisted, geniculate, from near the base to middle of lemma, or straight and shorter from about the middle or higher.

Lemma dull, light gray, weathered and porous in texture; opaque to slightly transparent; apex 3-veined, acuminate; lemma not keeled toward the base.

Shape ovate-lanceolate.

Palea tapers gradually toward the apex; variously notched, rarely truncate (Pl. 9).

Seeds smallest of the commercial bents (A. canina excepted). (A. tenuis, colonial bent (Pl. 3).

Seeds larger, robust, approaching redtop in size and shape. (A. tenuis, Astoria bent (Pl. 4).

Lemma slightly lustrous, light gray, or light straw-color and shiny; apex 3-veined, the veins often exserted beyond lemma; apex truncate, occasionally acute pointed; lemma not keeled but midvein usually faintly evident to the base; basal hairs mostly lacking; awns less frequent than in colonial and Astoria bents.

Shape linear-oblong or spindle-shaped.

Palea tapers gradually from the base, the apex uniformly deep V-notched (Pl. 9); rachilla segments frequent in some seed lots. . . . . A. tenuis, highland bent (Pl. 5).

II - Palea reduced to a minute scale, caryopsis soft.

Awns when present straight and frail, length variable.

Lemma opaque to slightly transparent, dull silvery gray, slightly granular; apex short-pointed, lightly 5-veined; midvein not at all or only faintly evident below the middle; lemma smooth and rounded at the base, completely covering the grain, or only the deep longitudinal groove of the grain exposed; basal hairs mostly long and appressed, callus narrow (vertically).

Shape linear- oblong.

Palea scarcely covers hilum, deeply V-notched...A. scabra (Pl. 7).

Lemma very thin, dull gray, mostly adherent and transparent, granular; often shorter than the grain; apex blunt, 5-veined, the midvein and sometimes the lateral veins evident to the base, giving an angled effect; the longitudinal groove in the plump grain usually exposed between the edges of lemma; basal hairs few and short or lacking; callus very narrow (vertically).

Shape narrowly ovate.

Palea very thin and minute, scarcely evident...A. hiemalis (Pl. 7).

Lemma very thin, dull gray, mostly adherent and transparent, coarsely granular, the granules chiefly confined to the 5-cord-like veins evident the entire length of the lemma; lemma usually completely covers the very soft grain; basal hairs long, copious and appressed; the thread-like awn from near the apex may be as much as twice the length of the seed.

Shape linear-oblong.

Palea nearly the length of the hilum....A. elliottiana (Pl. 6).

Awns coarse, twisted, geniculate, or reduced to a short prickle.

Lemma thin, dull gray, opaque or slightly transparent, the entire surface finely granular, sometimes adherent in spots; apex lightly 3 or 4-veined, the midvein occasionally faintly evident toward

the base; lemma may cover entire grain or the longitudinal groove in the very soft grain may be exposed; basal hairs few and short or lacking.

Shape linear-oblong.

Palea usually shorter than the hilum....A. canina (Pl. 6).

Lemma opaque, silvery gray, semi-polished, the edges overlapping on the face of the grain; midvein and sometimes the lateral veins evident to the base; basal hairs long and appressed, few, or wanting; callus thickened vertically; awns, arising well above the middle of lemma, may be coarse, twisted and geniculate, or reduced to a coarse prickle.

Shaped narrowly obovate.

Palea much reduced, broad in proportion to length.....
A. exarata (Pl. 8).

IDENTIFICATION OF SORGHUMS

Elva L. Norris

Kansas State College, Manhattan, Kansas

During recent years there has been an increase in the acreage of sorghum in the Middlewest. This has been due largely to the fact that it is extremely drought resistant. Its value as a forage and grain producer has become widely recognized.

Because of the confusion in names, the overlapping of groups and the hybrid derivatives which are constantly arising, it is impossible to definitely classify and identify all varieties of sorghums.

Since this situation exists it appears then, that we would be able to give only a limited amount of information. It is true that in many cases the variety cannot definitely be stated when only threshed seed is available. In the majority of cases one can determine whether the sorghum in question is a grain or forage variety. This in itself is extremely important information to the agriculturist. Seed of Darso has sometimes been confused with Kansas Orange. Darso is a dependable seed producer but its short, pithy stalks have little forage value in comparison to those of the tall, leafy, sweet-juicy ones of Kansas Orange. By certain seed characteristics it is possible to distinguish these two varieties. Hegari has been sold under the name of Blackhull Kafir and Atlas. Hegari is not generally recommended for Kansas while Blackhull Kafir and Atlas are more desirable varieties. Schrock has been mixed with Orange and offered for sale. Such mixtures as the two just mentioned can be detected.

However there are cases where positive identification is at present impossible. The seeds of Blackhull Kafir and Atlas bear such a close resemblance that the sorghum breeders hesitate to identify them. There are several strains of the Orange type whose seeds cannot be identified. At one time Standard Yellow Milo could be identified but plant breeders have produced a half dozen or more derivatives whose seeds are apparently identical.

Seed analysts deal directly with threshed seed and before identification can be made there must be definite characteristics present which will distinguish it from some other variety. It is a satisfaction to all of us to actually be able to identify any plant which produces the seeds with which we are familiar. This is especially true with sorghums. A knowledge of the characters of the sorghum plant as a whole would be very desirable.

Sudan Grass and Johnson Grass the so-called "Grass Sorghums" will not be included in this discussion. It is important that mention be made of broomcorn. Seed analysts should be familiar with the seed since it sometimes is used as an adulterant for grain or forage sorghums.

In the present discussion on identification only the characteristics of the spikelet and the caryopsis are considered. They are as follows: size, shape, color, seed coat markings, nucellar layer, embryonic region, color of glumes, and exposure of caryopsis. The following tables show that the sorghums have been divided into four groups based on color. They are white seeded, brown seeded, yellow seeded, and red seeded. This is in accordance with the Federal Grain Standards.

In addition to the representative types shown in Table I there are numerous additional White Seeded Sorghums. Derivatives from the Standard Blackhull Kafir include Western Blackhull Kafir, Dawn, Sunrise, Club, and Wonder. White Milo is rarely grown at the present time. The grain is similar to yellow milo in all respects excepting color. Tricker and Coe's are also White Seeded Sorghums of some importance.

Additional Brown Seeded Sorghums which were not included in Table II are Coleman, Collier, Folger, Lecti Red, McLean, Planter, Red Amber, Rex, and Sourless (African Millet).

Several of the numerous hybrid derivatives which have characteristics similar to Dwarf Yellow Milo, Table III, and which cannot be identified from threshed seed are Wheatland, Beaver, Sooner, Day, Colby, and Finney.

After studying the accompanying tables it is evident that sorghum varieties do differ in recognizable characters and that the problem of identification is not entirely chaotic. The seed analyst can give valuable service. For example in the majority of cases forage and grain types are distinguishable. The following white seeded varieties can be definitely identified: Hegari, Feterita, White Milo, White Durra, Cheyenne, and Pink Kafir. One can, with a trace of reservation, be reasonably sure of the following brown seeded varieties: Sumac, Shrock, Darso, and Grohoma. Kalo, Red Kafir, and the Milos are readily distinguishable.

The seed analyst has frequent opportunities to assist in educational campaigns. This statement was recently made by a Kansas educator, "Twelve well selected sorghum varieties would well serve for Kansas instead of the 35 to 40 which are now being grown." We should discourage the growing of something because it is different, and on the other hand, we should encourage the production of only a few standard varieties.

Vinall, H. N., Stevens, J. C., Martin, J. H. Identification, History, and Distribution of Common Sorghum Varieties. U.S.D.A. Tech. Bul. No. 506. 1936.

Variety	Class	Size	Shape	Color	Seed coat markings	Nucellar layer	Embryonic Region	Glumes	Exposure of caryopsis
Atlas	Forage and grain	Midsize	Obovoid to globose	Creamy white, reddish brown to black spots	Smooth	Absent	Merges into endosperm (variable)	Black	Much exposed
Standard Blackhull Kafir	Grain	Midsize	Obovoid to globose	Creamy white, reddish brown to black spots	Smooth	Absent	Sharply delineated (variable)	Black or brownish black	Much exposed and extends beyond glumes
Pink Kafir	Grain	Small to midsize	Ellipsoid to globose	Pink or nearly white. Pink flecks with color more solid at center	Smooth	Absent	Not sharply defined	Straw colored	Two-thirds exposed
Feterita	Grain	Large	Nearly globose. Flattened on dorsal side	Chalky bluish white. Red and black spots	Entire surface checked	Present	Concave. Germ lies at sharp angle to dorsal side	Black reddish brown straw-colored	Much exposed
Cheyenne (Sweet Stalk)	Grain and Forage	Midsize	Globose to ellipsoid. Lengthwise furrow on dorsal side	White. Dark spot at hilum	Smooth	Absent	Large-width of caryopsis. Merges into endosperm	Straw color to purplish	Slightly exposed
Hegari	Grain	Small to midsize	Obovoid to globose. Flattened on dorsal side	Bluish white with reddish brown to black spots.	Smooth hard coat	Present	Similar to Feterita	Black or reddish brown	Much exposed
White Durra	Grain	Midsize to large	Globose flattened dorso-ventrally	Creamy white red spots	Slightly checked	Absent	Large concave germ	Straw colored	Moderately to well exposed

TABLE 1. - BROWN SEEDED SORGHUM

Variety	Class	Size	Shape	Color	Seed coat markings	Nucellar layer	Embryonic Region	Glumes	Exposure of caryopsis
Black Amber	Forage	Midsize	Ellipsoid	Reddish brown	Smooth	Present	Definitely delineated	Black or brownish black.	Three-fourths covered
Orange	Forage	Midsize	Ellipsoid	Reddish yellow to dark brown. Spots of deep color.	Smooth	Present	End of germ attenuated to sharp point.	Straw to reddish brown	Much exposed
Kansas Orange	Forage	Midsize	Ellipsoid Slightly flattened on dorsal side	Reddish brown with dark spots and lighter where unexposed	Smooth	Present	Merges into endosperm	Reddish brown to black	Much exposed
Sumac (Redtop)	Forage	Small	Obovoid to globose "shot like"	Uniform dark reddish brown	Smooth	Present	Well defined	Black to reddish brown	Extends beyond glumes
Honey	Forage	Midsize	Obovoid to ellipsoid	Reddish brown	Smooth	Present	Not well defined. Definite ridge lengthwise.	Reddish yellow	Usually not exposed.
Darso	Grain	Midsize to large	Ellipsoid to obovoid. Flattened dorso, ventrally.	Yellowish brown to reddish brown on ventral side	Transverse striations on dorsal side	Present	Concave	Reddish brown to black	One-half exposed
Schrock	Grain	Midsize	Ellipsoid not flattened	Uniform yellowish brown to reddish brown. Dark spots	Smooth hard, dull looking	Present	Germ concave very distinct Shaped like a "mule foot"	Black or reddish brown	Much exposed
Grohoma	Grain	Midsize	Globose to obovoid Flattened on dorsal side	Buff, light brown or creamy white	Smooth	Present	Forms sharp angle to dorsal side	Black to dark reddish brown	Considerably exposed

TABLE 3.-Yellow Seeded Sorghum

Variety	Class	Size	Shape	Color	Seed coat markings	Nucellar layer	Embryonic Region	Glumes	Exposure of caryopsis
Dwarf Yellow Milo	Grain	Large	Obovoid to globose	Salmon	Smooth	Absent	Parallel to dorsal side Radicle points upward	Black to reddish brown straw colored	Much exposed

TABLE 4. - Red Seeded Sorghum

Variety	Class	Size	Shape	Color	Seed coat markings	Nucellar layer	Embryonic Region	Glumes	Exposure of caryopsis
Red Kafir	Grain	Midsize	Obovoid to globose	Reddish brown yellowish red Often dark spots. Glassy appearance	Smooth	Absent	Well-defined (variable)	Straw colored to reddish brown	Much exposed laterally in angles
Kalo	Grain	Midsize	Obovoid to globose	Pale yellowish dark spots	Smooth	Absent	Radicle tips upward	Straw color to pink	Much exposed laterally in angles

COMPARISON OF IOWA AIR-BLAST AND KENTUCKY SEED BLOWER

Erle C. Vaughn

Kentucky State College
Lexington, Kentucky

These machines are essentially the same in principle; separating light from heavy seed in a vertical air chamber.

The Iowa Air-blast uses a metal tube, loaded from the lower end, retaining light seed in a trap near the top, and depends on a motor driven fan for uniform air current; while the Kentucky blower uses a glass tube, loaded from the upper end, blowing light seed out into another container, and depends on a hand operated valve and compressed air tank for uniform current.

An expert operator can get fairly uniform results with either, or both, of these blowers.

(Note: Tubes from each of these blowers were on display as well as the complete machine so that members could operate either if they so desired.-Ed.)

Additional Program Features

Other features on the program for which no manuscripts or reports are available, together with the names of the members who presented and discussed them are as follows:

1. Normal and Abnormal Seedlings (photographs, Koda-Chrome Slides, Specimens) by W. A. Davidson, Vera Drake, G. T. French, M. T. Munn, W. C. Pfaender, R. H. Porter, E. H. Toole

It has seemed from time to time that much of the difficulty between analysts in arriving at agreement as to seedlings that should be considered abnormal is due to the fact that they have not had before them descriptive matter which attempted to catalogue the various types of seedlings. In an attempt to meet this and spurred on by the needs for standardizing procedure in the administration of the Federal Seed Act, the Department during the past year or so has photographed the seedlings of many kinds of seeds showing those which were interpreted by the Department as normal and those which were interpreted as abnormal. These photographs were made available for distribution primarily to permit official and commercial analysts to determine more specifically how the Department made its interpretations in determining the germination of seeds subject to the Federal Seed Act. They were sold to the analysts at ten cents each and an announcement of the kinds of seeds and the number of prints available for each kind was included in issues of the Associations' News Letter.

We have had no criticism of these photographs from the standpoint of the interpretations made. However, we are anxious to receive such criticisms in order that such corrections or changes in interpretation as may be warranted may be made at the earliest possible date. It is our feeling that if these photographic prints should be of assistance to analysts, that certain prints, over a period of time may be regarded as a guide with respect to the different abnormalities which are found displayed in the prints. It is conceivable to us that the analysts would be well served by having a notebook containing such prints by their side as they appraise the germination tests. - W. A. Davidson, Discussion Leader.

2. Abnormal Germination of Coniferous Tree Seeds. . . . . C. E. Heit
3. False Wild Oats . . . . . W. H. Weight
4. Field Control Plantings (Symposium) . . . . . M. T. Munn
5. Motion Pictures on Weed Seed Germination . . . . . C. N. McIntyre
6. New Gadgets . . . . . E. L. Erickson, R. H. Porter, M. T. Munn
7. Sampling Methods and Discussion, W. A. Davidson, C. W. Leggatt, A. S. Carter
8. Sand Test Demonstration . . . . . C. W. Leggatt
9. Some Experiments with a Commercial Germinator . . . . . M. T. Munn
10. Sorghums . . . . . Elva L. Norris
11. Soybean Identification . . . . . W. C. Pfaender

Actions taken by association, 5
Agropyron, species characters, 124
Agrostis seed analysis, 32
Agrostis species diagnostic characters, 139
Allium bulblets viable, 109
Analysis of seed with the Rice laboratory seed cleaner, 70
Analysis of small seeds, report, 32
Auditing committee report, 8
Baldheads in beans; occurrence and influence on yields, 118
Bibliographers report, 9
Brassica species seeds, 132
Business of association, 4
Casey, John E. 15
Clark, Ben E., 90
Committees, 3
Comparative laboratory and field germination of onion seed, 90
Comparison of Iowa air-blast and Kentucky seed blower, 156
Correlation of laboratory and field tests of alfalfa seed, 28
Crop-producing value of discolored alfalfa seed in Montana, 28
Crosier, Willard, 104, 114, 118
Cullinan, Bette, 67
Dallis grass seed analysis, 72
Davidson, W. A., 58
Decker, Anna E. 48
Diagnostic characters of seed of the commercial species of Agrostis, 139
Distinguishing characters of the seeds of four species of Agropyron, 124
Dodder observations, 47
Dormancy in cultivated mustard, 17
Editorial committee report, 9
Evaluation of weed seeds, 47, 48, 49, 109
Equipment for seed analytical work, 26
Executive board report, 4
Experiments in the development of bluegrass seed, 77
Euphorbia marginata seed germination, 78
Everson, L. E., 68
Federal seed law administration, 58
Fergus, E. N., 77
Germination response of vernalized Taraxacum seed, 88
Germination of green foxtail seeds, 78
Germination of snow-on-the-mountain seed, 78
Germination of sweet clover seed, 21
Handbook committee report, 27
Hardseededness in peas, 114
Hay, W. D., 40
Heit, C. E., 78
Heise, A. C., 18, 48
Hooker, Dorcas, 47, 49
Identification of sorghums, 151
Injured weed seeds, 47
International analysis certificates prove efficient, 67
Justice, O. L., 109
Kanipe, Louisa Ames, 32
Kinch, R. C., 13
Leggatt, C. W., 44
Legislative committee report, 11
Lewis, N. G., 16
Membership committee report, 5
Message from American Seed Trade Association, 57
Methods for analysis of small seeds, 32
Methods and materials for controlling seed-contaminating microorganisms, 104
McCullough, A. Trimble, 57
McIntyre, C. N., 10, 51, 63
McLaughlin, F. H., 5, 51
Miller, Grace E., 47
Minutes, 5
Munn, Helen L., 82
Munn, M. T., 9, 88
Munn, Myrta S., 72
Musil, Albina F., 124, 132, 139
News Letter, editors report, 10
Norris, Elva L., 43, 151
Nutile, G. E., 99
Officers of association, 3
Onion seed germination, 90
Onion seedlings devoid of roothairs, 99
Patrick, Stewart, 114
Porter, R. H., 26, 77
Persistent hardseededness in peas, 114
Presidential address, 51
Program committee report, 51
Program freatures, 156
Public service committee report, 13
Phytopathological studies report, 40
Qualifications committee report, 26
Qualifications for analysts, 26
Range grass seed studies, 43
Research committee report, 16
Resolutions committee report, 6
Rice laboratory seed cleaner, 70
Sand as substratum, 44
Seeds of commercial species of Brassica, 132
Seed trade report, 57
Snow-on-the-Mountain seed data, 78
Sorghum identification, 151

Special committees, 3, 25
Special committee on standardized tests, 25
Standing committees, 3
Standardized tests report, 25
Staker, E. V., 82
State seed law administration, 63
Steinbauer, G. P., 16, 23
Subcommittee projects, 3
Sweet clover seed germination, 18
Taraxacum seed germination, 88
Thompson, Bertha B., 70
Toxicity to seedlings of zinc from germinator trays, 82
Treasurer's report, 8
Treatment of multiple florets, 77
Vaughan, Erle C., 156
Vernalized Taraxacum seed, 88
Viability of injured weed seeds, 47, 48, 49
Viability of bulblets of Allium canadense and A. vineale, 109
Weed seed germination, 47, 48, 49
Weed trends in red and alsike clover seed, 16
Wheat seed damage by Say's grain bug, 16
Whitcomb, W. O., 27, 28, 70
Whitehead, M. D., 109
Wild onion bulblets, 49
Wright, W. H., 11, 26
Zinc from germinator trays toxic, 82